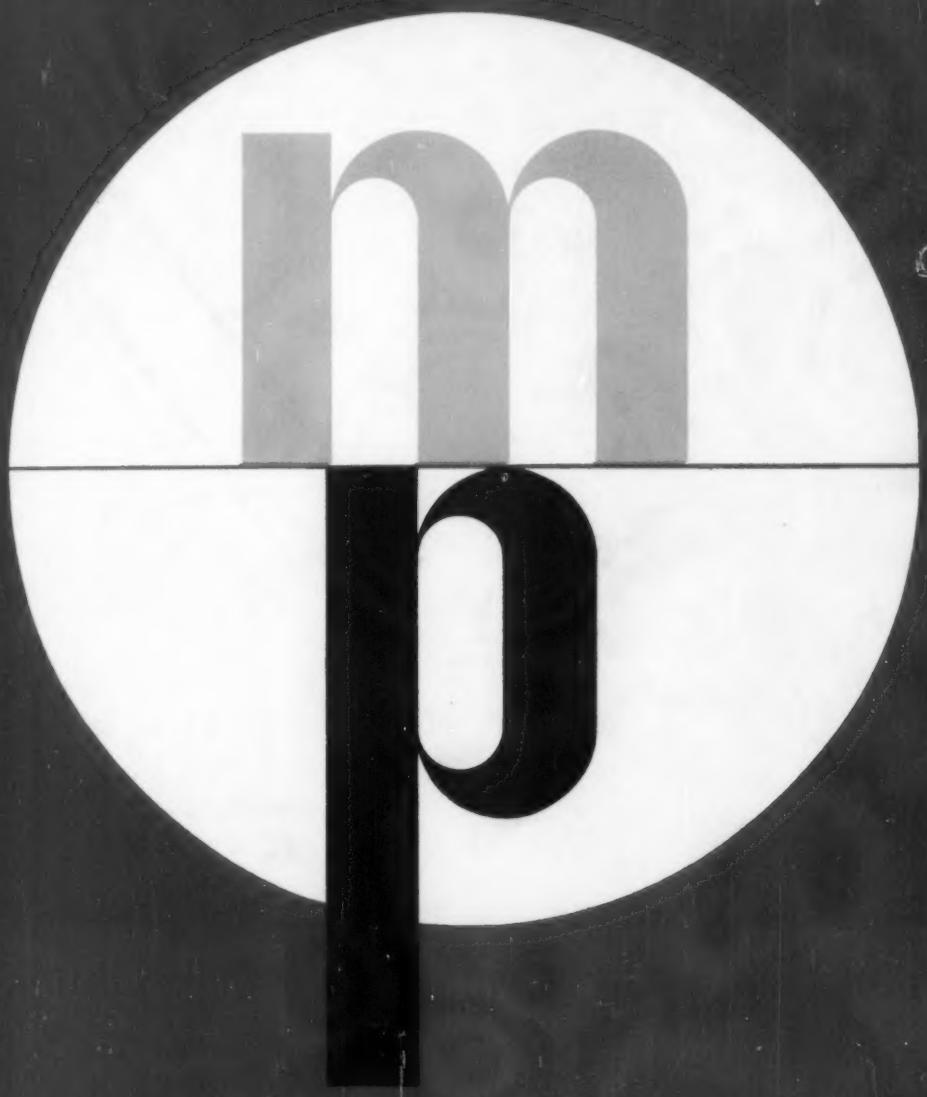
MODERN PLASTICS



October 1956

page 45 **The Plastiscope, Section 1 . . . vital news of the industry**

page 123 **Market boom in king-sized polyethylene moldings**

To **AVOID CORROSION** *of*
sealed-in switch contacts



Ultra-small precision switch
manufactured by Micro Switch Division,
Minneapolis-Honeywell Regulator Co.,
Freeport, Illinois

. . . take a closer look at

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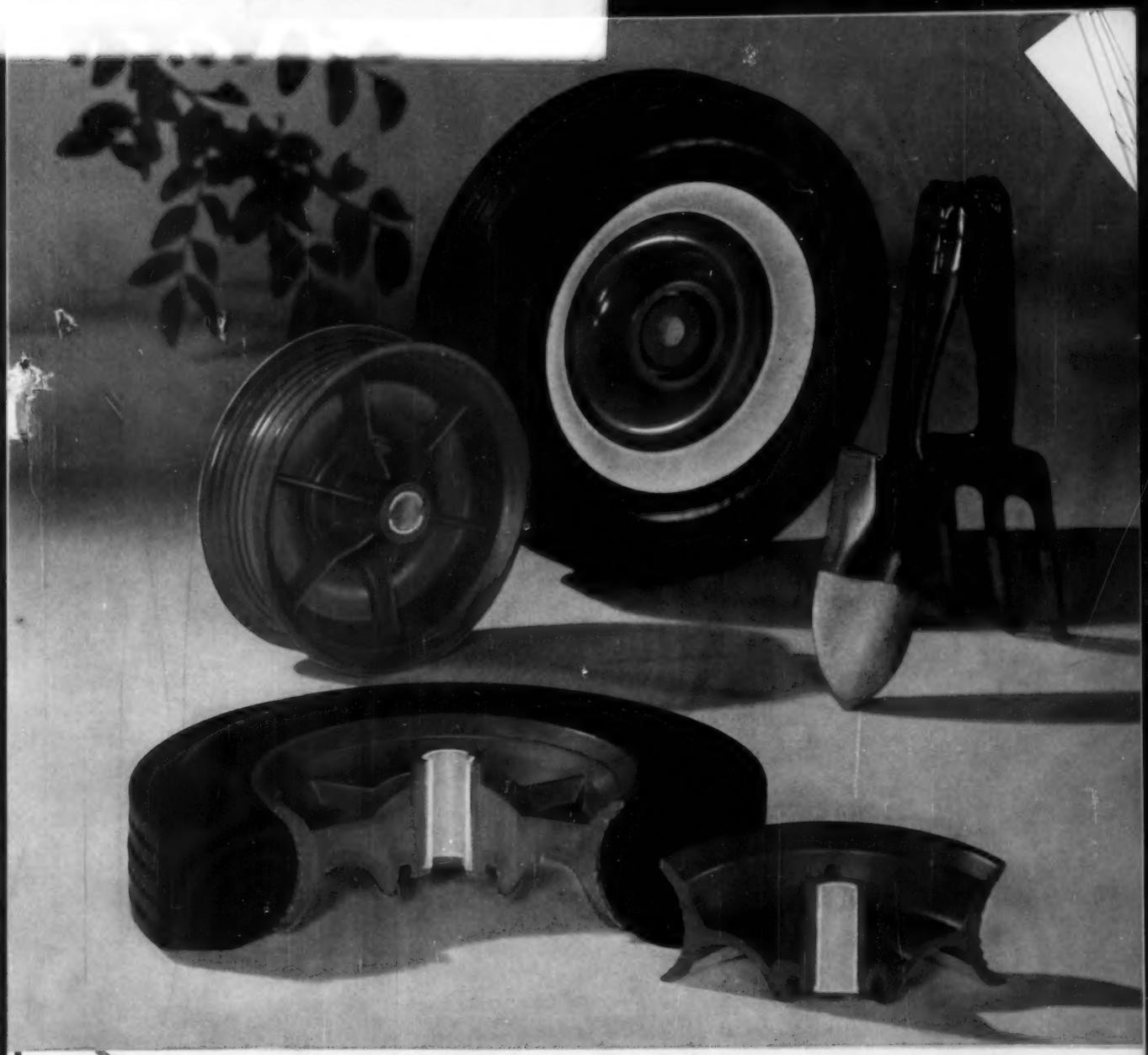
HOOKER CHEMICALS PLASTICS

DUREZ PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

1210 WALCK ROAD, NORTH TONAWANDA, N. Y.

king-sized polyethylene moldings





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Catalin NYLON AND STYRENE

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The tubular bearing (wall thickness 1/16") is molded of tough, load-sustaining, low-friction CATALIN NYLON—an easier-to-mold, caprolactam type. It will never require oiling. The wheel frame is molded, with this finished bearing-insert in place, of CATALIN Extra High Impact STYRENE. The result is that of a complete one-piece, light-weight plastic wheel structure with long-service-life qualities.

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CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

Catalin

MODERN PLASTICS*

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October
1956
Number 2

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Another new development using

B.F.Goodrich Chemical *raw materials*



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For new booklet describing the many ways in which you can use Geon write Dept. DS-10, B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



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polystyrene bandsaw cover made lighter, stronger, at lower cost...

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Let Chicago Molded's service engineers help re-examine your products. They may be able, just as they did for Magna, to suggest ways to make them better, and lower cost through the use of molded plastic parts. And our unbeatable facilities mean prompt, economical delivery of *any* size part you need . . . in *any* quantity. *That's why 60% of our business comes from firms we've served for 15 years or more.*

If you'd like to receive news of new plastic applications and developments, send us your name and address. We will be glad to send you periodic copies of the magazine *Plastics Progress.*

CHICAGO MOLDED PRODUCTS CORP.
1046 North Kolmar Avenue, Chicago 31, Illinois

Editorial

The highway program

Begun only a few months ago, the nation's highway construction and modernization program looms larger for the years ahead as an economic factor than almost any other project except home, commercial, and industrial construction.

Present plans cover 41,000 miles of interstate super highways, 200,000 miles of state highways, and 508,000 miles of rural roads.

A Bureau of Public Roads projection shows that almost 49 million tons of structural and reinforcing steel, 1399 million barrels of cement, 128 million tons of bituminous materials, 9710 million tons of aggregate, 7194 board feet of lumber, 48 million tons of culvert pipe, and 983,000 tons of clay pipe and tile will be required to implement the program over the 13-year period—1956-1969.

No mention of plastics!

We have news for the Bureau of Public Roads, for every contractor and supplier of materials involved in this colossal endeavor, and for every tax payer concerned: plastics are going to play an important part in this task.

First, there is the matter of resin additives for concrete and clay to render them more durable under all circumstances of application in flat areas as well as in culvert pipe and tile.

Second, there is the development of polyethylene frost and moisture barriers wherein the polyethylene film is placed over the base of the road bed and has cast on top of it the concrete or other road surfacing material. This barrier prevents moisture and frost from disturbing the surfacing material, lending longer life.

Third is the use of film over the freshly poured concrete to maintain relative moisture balance of the mix during cure.

Fourth is the reinforced plastics utility pole, now undergoing severe tests.

Fifth is the addition of resins to bituminous materials to make them more heat resistant and more abrasion resistant.

There are many other uses for plastics in this huge program and various interests in the industry are engaged in development and testing projects to the end that this market may be gained.

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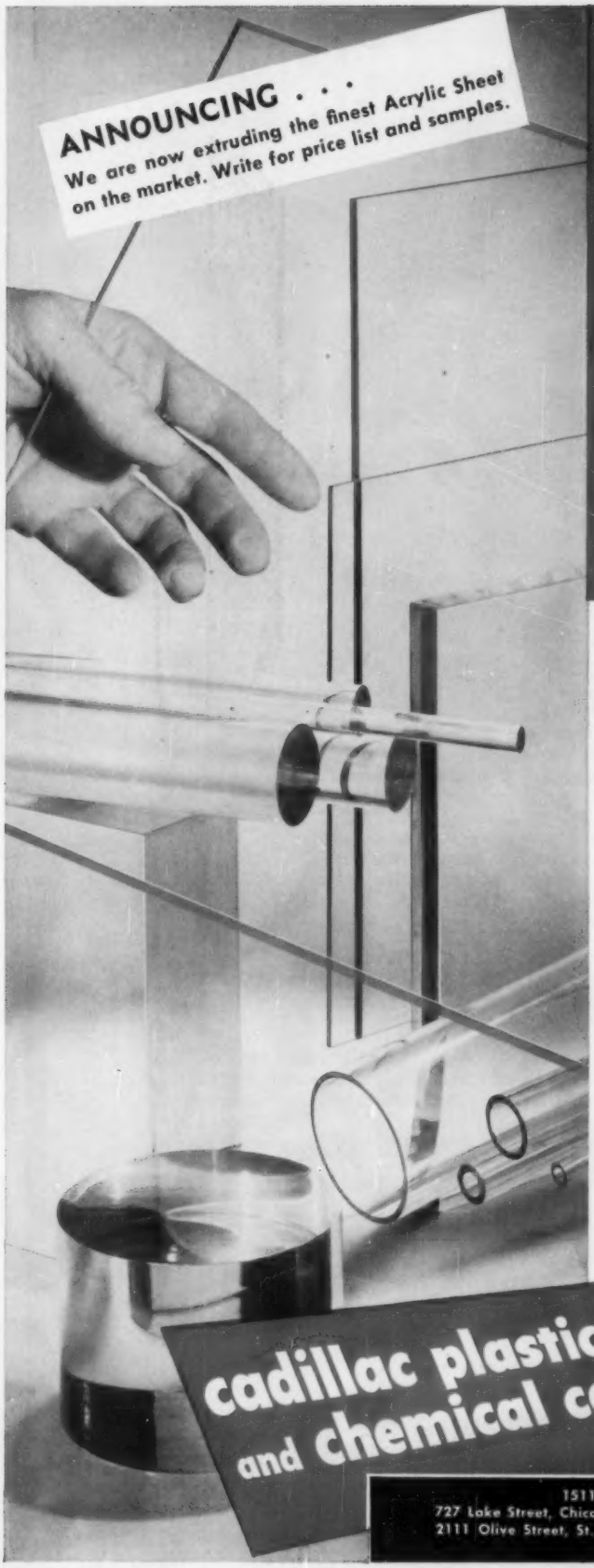
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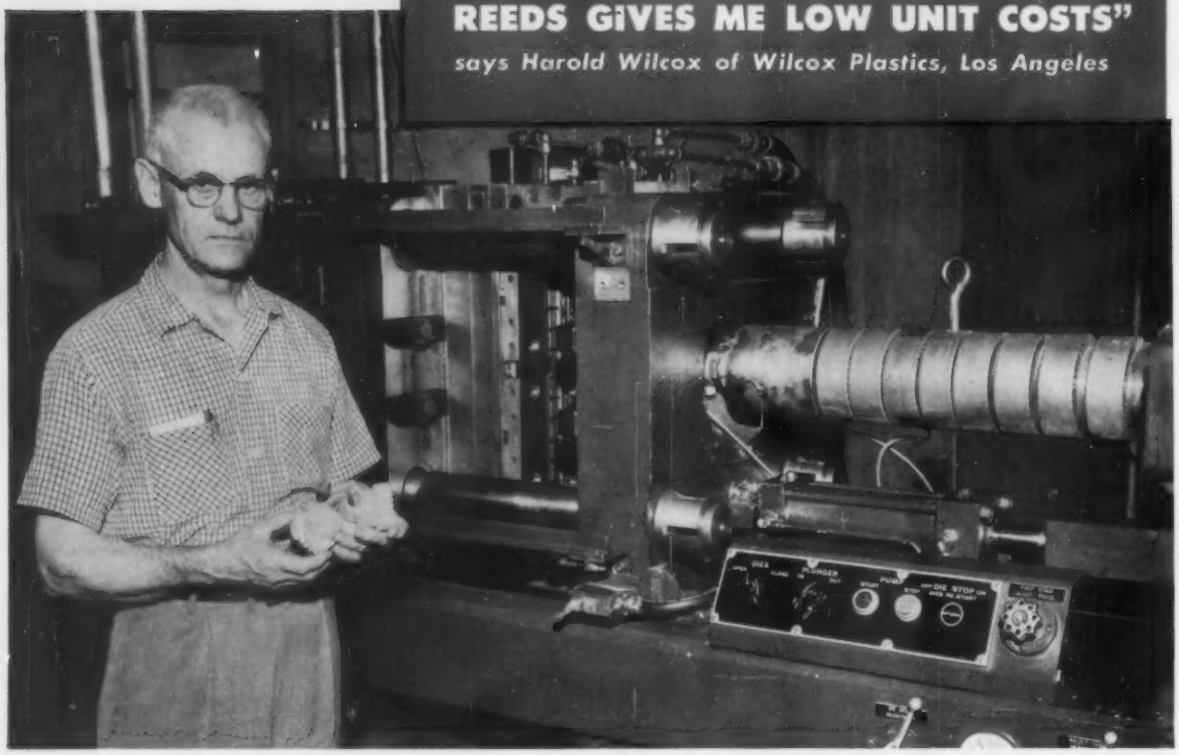
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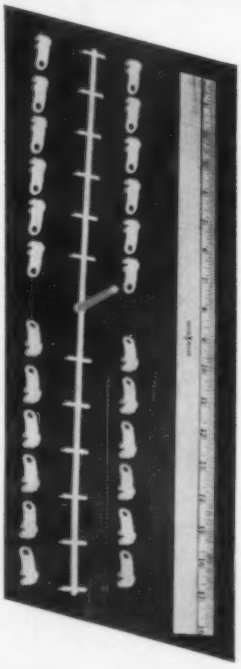
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"AUTOMATIC NYLON MOLDING ON REEDS GIVES ME LOW UNIT COSTS"

says Harold Wilcox of Wilcox Plastics, Los Angeles



Note how the 24-cavity mold extends at least an inch above the die plates on this 175T — 4/6 oz. machine. With full locking tonnage on every shot, flash is no problem. Running a fully automatic cycle, the nylon pieces are automatically degated as they eject. This is a good illustration of the "plus" capacity molders have come to expect in any REED.



"One operator runs our 175T REEDS," says Mr. Wilcox. "With automatic operation, we get a variety of precision nylon parts at an amazingly low cost. On one job, we run slightly oversized, 24-cavity molds, produce over 8,600 parts per hour on each machine with a 10-second cycle."

What is being done at Wilcox Plastics is further testimony of the speed and ruggedness of the 175T — 4/6 oz. REED. In addition to high-capacity molding, you'll find many other features standard in this machine. For instance:

- An exclusive nozzle for nylon molding, which prevents drool and eliminates any special heating cylinder equipment.
- Speeds up to 600 cycles an hour.
- Automatic toggle lubrication, and simplified electrical and hydraulic systems, to help slash maintenance costs.

To get full information on any of the six REED injection models available from 4 to 32 oz. capacities, or to find out about the revolutionary new *Autoflow* extruder, contact your nearest Reed-Prentice Sales Engineer.

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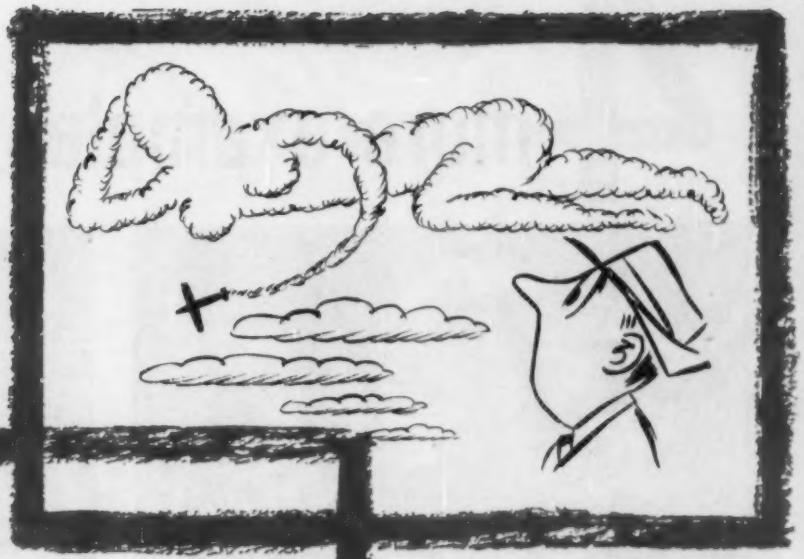
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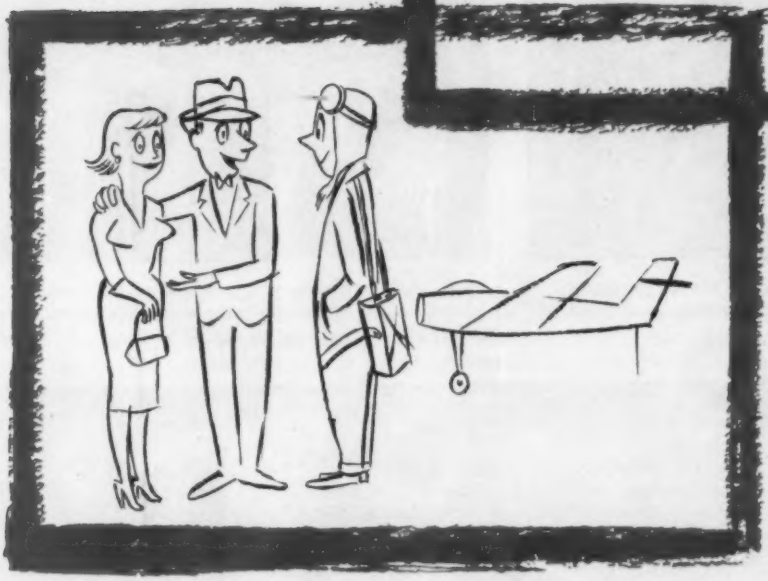
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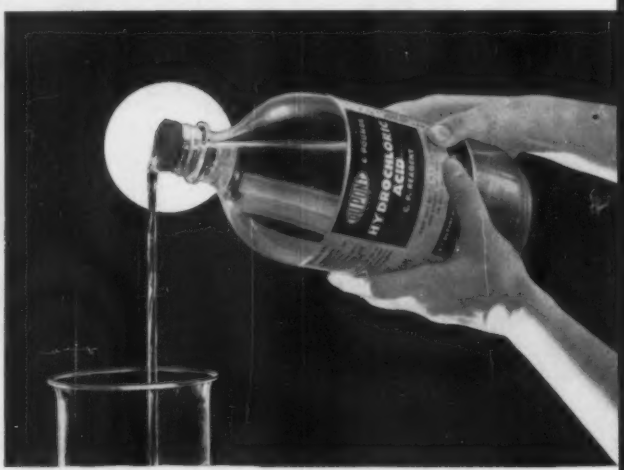
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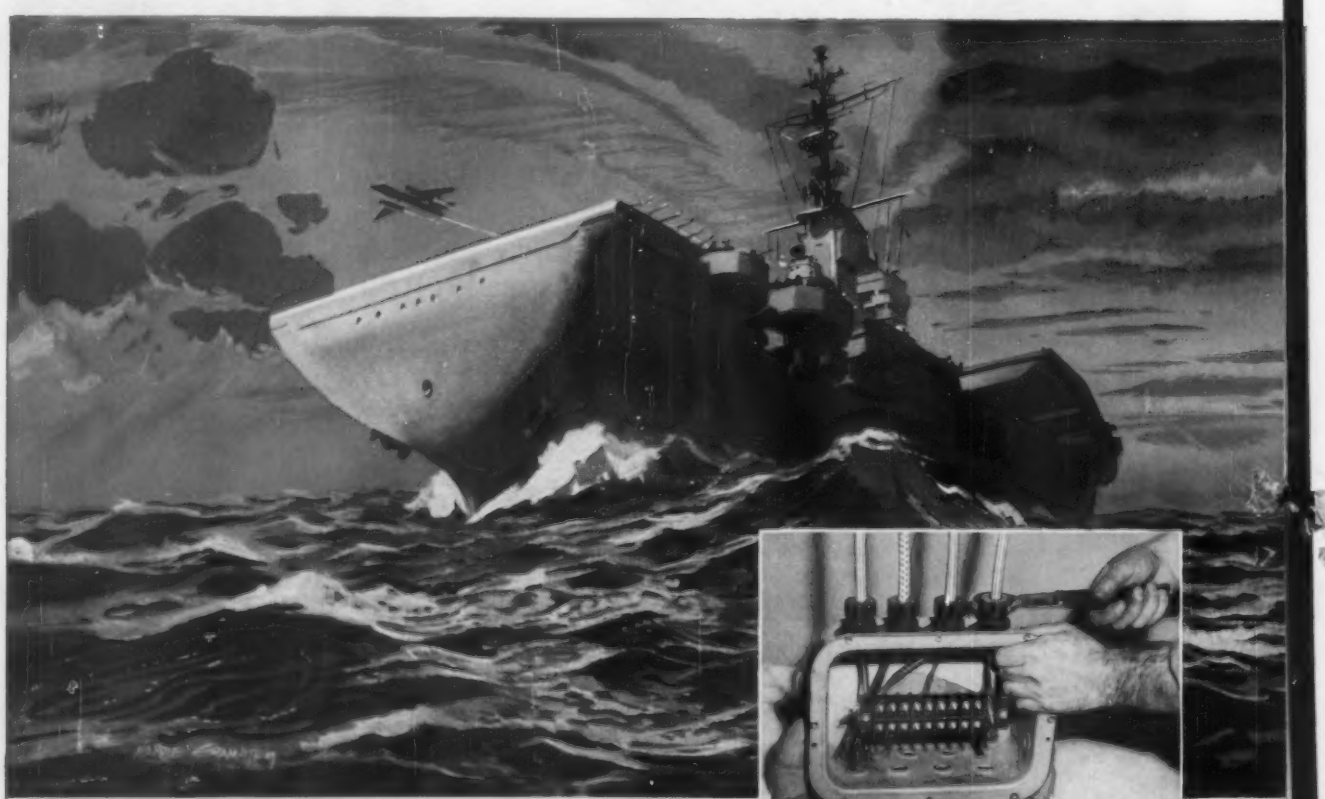
4 more examples of advanced



TEFLON® gives resiliency to this clamp. TEFLON performs efficiently at extremely high temperatures and has excellent chemical stability and age resistance.



ALATHON® provides dripless sleeves for chemical bottles. Sleeves of ALATHON polyethylene resin increase handling safety by eliminating drip during pouring.



ZYTEL® replaces metal for conduit fittings on U. S. Navy aircraft carriers. Easily molded, rugged ZYTEL cuts weight and saves the Navy over $31,000 per carrier in this application.

product engineering

Manufacturers who replace conventional materials with Du Pont engineering materials find that their use often simplifies design, increases product efficiency, and lowers costs. Here are typical examples of design improvement. They may suggest ways in which you can utilize these versatile materials in your operation.

ALATHON® polyethylene resin provides a new, dripless sleeve for use on chemical bottles. The sleeve of ALATHON, fitted to the neck of the bottle, eliminates drip during pouring, increasing handling safety in the laboratory. The properties of ALATHON make it a superior packaging material for many uses. It is used in the form of film, bottles and other containers, closures, liners for metal and fiber drums and multi-wall bags. The chemical and physical properties of ALATHON remain unchanged with age. (Sleeve molded by the A. L. Hyde Company, Grenloch, New Jersey.)

LUCITE® acrylic resin is used for the Sun Dial and sun-strength indicators of the new Bell & Howell Monterey camera. Stability, lightness in weight, resistance to color fading and simplification of design were factors which determined the selection of LUCITE for these parts of this precision product. Easily colored and molded, LUCITE has a variety of properties which make it useful both as a functional and as a decorative material. (Dial and indicators manufactured by Pereles Brothers, Inc., Milwaukee, Wisconsin, for Bell & Howell Company, Chicago, Illinois.)

ZYTEL® nylon resin used as a replacement for metal in electrical conduit fittings, is helping the U. S. Navy save weight and reduce costs in aircraft-carrier design. Fittings molded of ZYTEL are 80% lighter than the metal parts replaced. Because of improved design, 9 sizes now do the job that used to require 27. Products molded of ZYTEL feature toughness, abrasion resistance, form stability at high temperatures, strength in thin sections, lightness in weight, and chemical resistance. (Fittings molded by Danielson Mfg. Co., Danielson, Connecticut.)

TEFLON® tetrafluoroethylene resin, used in the liner of a clamp, forms a resilient, high-dielectric-strength device. The clamp is especially suited for the support of high temperature, air-borne fluid or power communication lines. In other applications the self-lubricating characteristics of TEFLON assume importance. A coefficient of friction of TEFLON as low as .04 has been measured. TEFLON has good impact strength and toughness at temperature extremes of 500°F. to −450°F. (Joclamp manufactured by Joclin Manufacturing Company, North Haven, Connecticut.)

* * *

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LUCITE® is used to mold the dial and sun-strength indicators of this modern, quality 8-mm. movie camera. Molded to close tolerances, LUCITE requires little or no finishing operation, is available in a wide range of colors.

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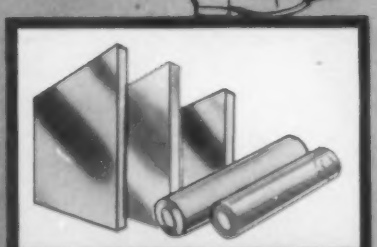
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THE MOST ADVANCED PLASTIC PROCESSING EQUIPMENT

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IN USE IN THE UNITED STATES AND THROUGHOUT THE WORLD

West Coast Representative: 8510 Warner Drive, Culver City, Calif.

GASKETS THAT FLOW ANYWHERE, then can be foamed and fused in place to give tough, tight seals at great savings in time and labor, are made of plastisols based on PLIOVIC.



FINISHED BEFORE IT WAS FORMED, this beautiful television cabinet won't chip, crack or craze, defies abuse, abrasion and age. It's made of sheet PLIOVIC laminated to metal.



What do Flowable Gaskets, Flying



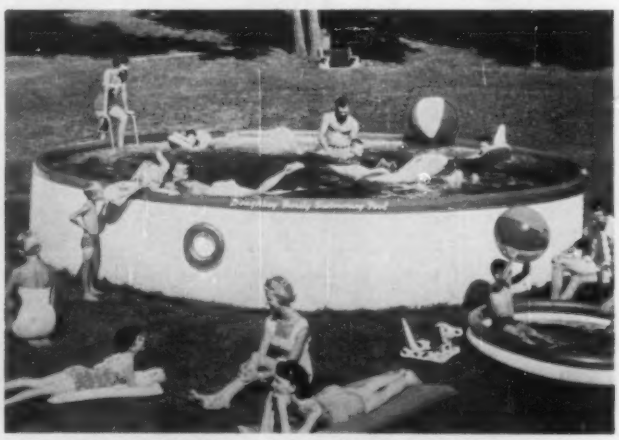
WALLS THAT FLY are these attractive panels of calendered PLIO-TUF for aircraft interiors. They are strong, light in weight and highly resistant to impact at low temperatures.



TRUE MEASURE OF QUALITY AND QUANTITY is offered by this pump with liquid end molded of impact- and chemical-resistant PLIO-TUF. Unique construction permits the accurate metering of the most corrosive liquids and slurries.



CRYSTAL-CLEAR SHOWCASES for soft goods are made from tough, transparent film of blown PLIOVIC. It is easily heat-sealed to form dust-free package—resists roughest handling.



KING-SIZED KIDDIE POOL lets whole family swim in backyard. It's made of heavy-duty PLIOVIC sheeting for high strength and resistance to water, sunlight, hard wear and age.

NEW KIND OF CARPET consists of thin sheet of PLIOVIC laminated to heavier rubber sheets. Brightly colored and easy cleaning, it outwears all-rubber mats up to 20 times over.



COLORFUL CLUES for assemblers and users of electronic computers are supplied by wire coverings extruded from PLIOVIC. They provide excellent insulation—are extremely durable.



Walls and Prefinished Cabinets have in Common?

Here are eight products that differ widely in appearance and application. But they do have something in common: Each was made possible by raw materials and services offered by the Plastics Department of the Goodyear Chemical Division.

The materials involved are PLIOVIC and PLIO-TUF. PLIOVIC is the family name for a series of easy processing vinyl resins. PLIO-TUF is the name for a family of high impact styrene resins. They are materials designed to keep pace with the progress constantly being made by the plastics industry.

The services involved range from those of strategically located sales offices and warehouses to well-equipped service laboratories to modern production plants to extensive research facilities. All are staffed by specially trained, experienced personnel to meet the demand for increasingly specialized technical service.

The Plastics Department is new, yet not new. It results from a recent reorganization designed to give customers of the Chemical Division the ultimate in service and quality. It combines experience with the verve and vitality of a new organization well equipped to make its mark in a highly competitive market.

Why not learn how the new Plastics Department can give your present or potential product something in common with those shown here—success! You can, simply by writing and asking for help to: Goodyear, Chemical Division, Dept. V-9422, Akron 16, Ohio.



Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

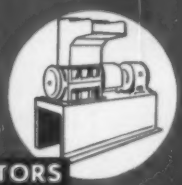
CHEMICAL
GOODYEAR
DIVISION

PLASTICS DEPARTMENT

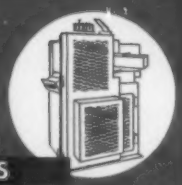
CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

In Plastics Reducing Machinery, Look to CUMBERLAND for the COMPLETE LINE



GRANULATORS



DICERS



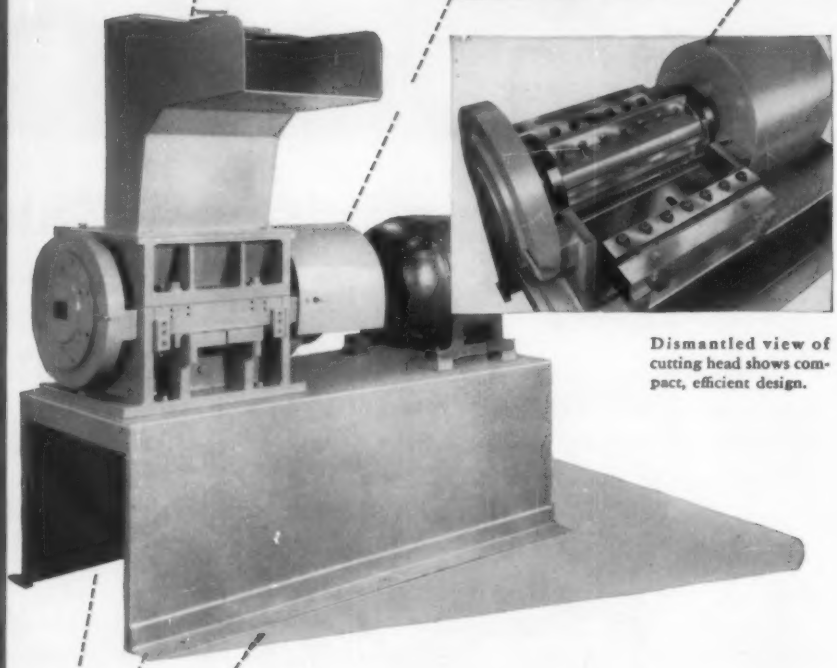
CHOPPERS



PREBREAKERS

MODEL 20 All Steel Granulator

CUSTOM ENGINEERED QUALITY BUILT



Dismantled view of cutting head shows compact, efficient design.

1 HEAVY DUTY — Large flywheel—thick all-steel weldments—deep welds—parts are of flawless wrought steel (not steel castings)—machine resists wreckage.

2 LARGE THROAT OPENING — 8 by 20" size.

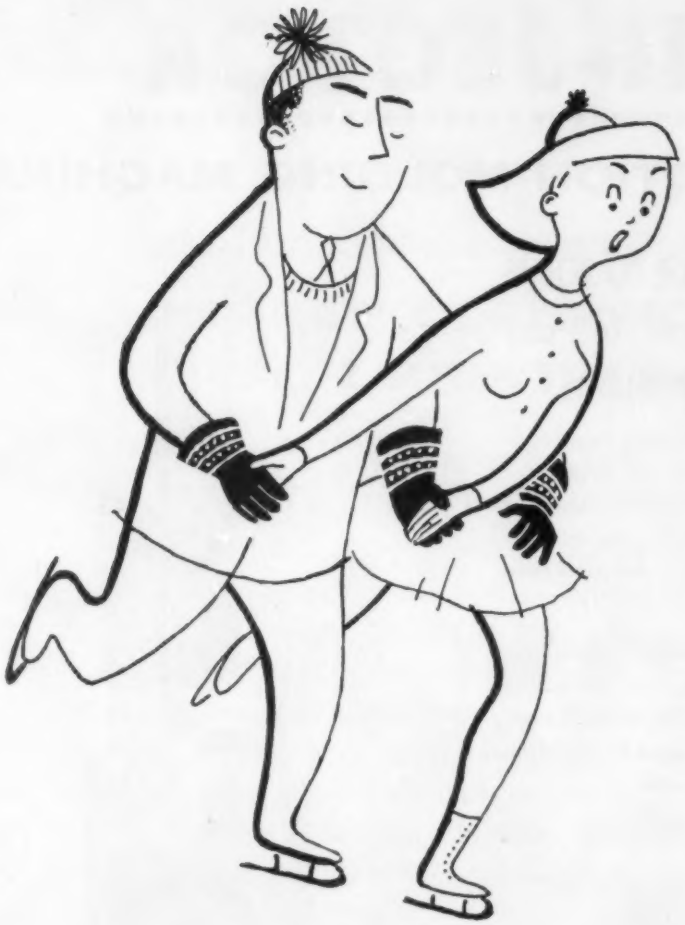
3 PRIOR BANDSAWING NOT NEEDED — Machine specially built to handle large chunky parts such as bleeder scrap, cylinder purgings and heavy cast slabs of polystyrene, modified polystyrene and acrylic resins.

CUMBERLAND Engineering Company Inc

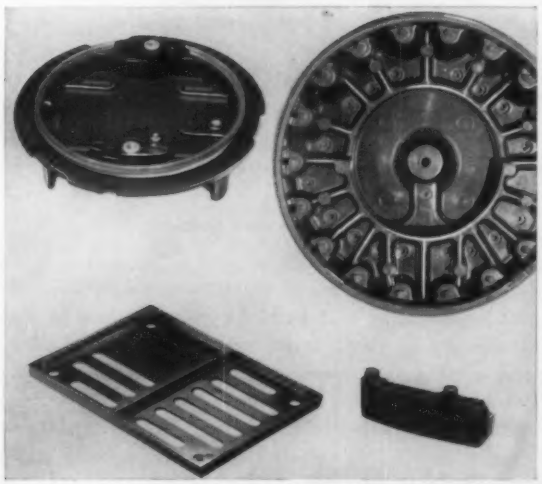
BUILDERS OF BETTER MACHINES FOR THE PLASTICS INDUSTRY

DEPT. I · BOX 216 · PROVIDENCE · RHODE ISLAND

California Representative:
WEST COAST PLASTICS DISTRIBUTORS, INC.
4113 West Jefferson Blvd., Los Angeles 16, Cal.



a helping hand



in plastics too... the *"extras"* are what count most.

On one hand . . . they're important when you're *skating around* for a reliable supplier . . . *on the other* . . . its reassuring to have the *extra cushion of knowledge* only Kurz-Kasch can supply to *cover your vital parts.*

If the part, you need calls for thermo-setting materials that can be compression, transfer or plunger-moulded . . . *you've got to hand it* to Kurz-Kasch. *These good skates* can guide you away from thin ice and dollar dwindling dangers. They can give you the low-down on the highlights of standard thermosetting plastics and the newer Teflon or glass-filled polyesters. And speaking of *gay blades* . . . here, *they turn on the heat to help you thaw out your frozen assets.*

Can Kurz-Kasch give *you* a hand?

BRANCH SALES OFFICES

New York,	Mt. Vernon..MO 4-4866
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Help! Send your representative to our rescue. We have a thermosetting plastic problem.

name_____

title_____

company_____

address_____

city_____ state_____

SPECIALISTS IN THERMO-SETTING PLASTICS FOR 40 YEARS.

kurz-kasch

1415 S. BROADWAY, DAYTON 1, OHIO

MINI-JECTOR

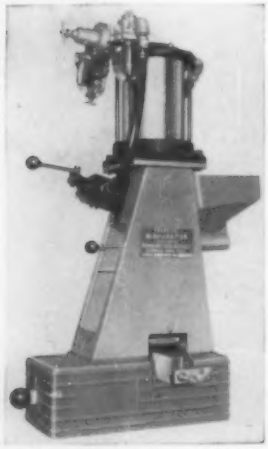
TRADE MARK

PLASTIC INJECTION MOLDING MACHINES

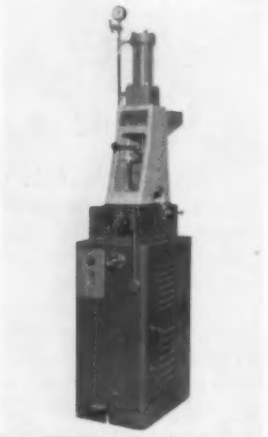
THERE IS A MINI-JECTOR MADE TO SOLVE YOUR SMALL CAPACITY (⅓ oz. to 1 oz.) INJECTION MOLDING PROBLEMS

Mini-Jectors are ideal equipment for developing new plastic products. You can make a few dozen, several hundred or thousands in the exact color and design you need to test market reaction before tooling up for full production. In many cases the Mini-Jector will take care of the entire production requirements.

All Mini-Jectors feature simplicity of design, rugged construction and smooth, easy operation with all of the quality features of the finest precision equipment. No special knowledge or skill is required for efficient operation of any Mini-Jector.



MODEL 45 "WASP" ¾ oz. capacity air-operated Mini-Jector . . . fast and economical. 6" air cylinder operates ram . . . 40 to 150 pounds of air pressure required depending on type of plastic used and product being molded. Material hopper capacity 4 pounds.



MODEL 50 "WASP" a new Mini-Jector . . . capacity 1/3 oz. to 1 OUNCE at pressures up to 30,000 PSI. This is an ideal model for precision insert work with any type of plastic. Hydraulically operated.



MODEL 60-PC 75 "HORNET" POWER OPERATED, LEVER CONTROLLED. Mold size 6" x 5" x 5⅛"

This model retains all of the time-tested features of our popular 60-HC75 with the added feature of hydraulically operated, lever controlled mold opening and closing for faster, easier production. Like all Mini-Jectors the 60-PC75 gives you the most economical way of injection molding articles in the capacity range of ⅓ oz. to 1 oz., where modest scale production is required.

EVERY DAY THOUSANDS OF ITEMS ARE BEING PRODUCED PROFITABLY ON MINI-JECTORS

WRITE TODAY . . . for literature telling how Mini-Jector may help solve your injection molding problems, to . . .

NEWBURY INDUSTRIES, Newbury, Ohio

"Specializing in the Production and Development of Plastic Injection Molding Machines up to one ounce capacity."

TECHNICAL BULLETIN | **RESEARCH DIVISION**

date: **OCT. 1, 1956**

subject:

VALLEY—GRAVURE—LAMINABLE

THREE CLAREMONT INKS FOR PRINTING VINYLS

All process and blotch colors—
rub resistant bronze golds, too.

Claremont vinyl inks are distinguished by dependable, uniform working qualities. They give top quality results with conventional equipment and thinners. Stock formulations for valley, gravure and laminable printing. If your requirements are special, we can develop formulations to meet your needs. Ask for our Technical Bulletins Nos. 309 and 340. Data is ready also on our ink service for polyethylene printing.



CALIBRATED VINYL COLOR DISPERSIONS

For Calendering—Plastisol—Extrusion

Claremont's system of color calibration, a proven production time saver, enables vinyl calenderers to run as many as eighteen different colors per day without down time. Color range of Claremont dispersions is spectrum wide, includes non-tarnishing metallics also. The data in our Technical Bulletins Nos. 175 and 140 are practical and valuable to vinyl fabricators. Ask for your free copy.

Remember that the formulation of plastic colorants and plastic printing materials—calibration and maintenance of color uniformity—are continuously applied sciences at Claremont.

Claremont is an information and service center on plastic coloring and printing problems.

Our engineering suggestion and advice are always yours for the asking.

CLAREMONT *pigment dispersion corp.* ■ *39 powerhouse road, roslyn heights, l. i.*

INJECTION MOLDERS BOOST PRODUCTION!

IMS

EXTRA CAPACITY REPLACEMENT HEATING CYLINDERS

A PERSONAL MEMO TO ALL INJECTION MOLDERS FROM OUR SHOP FOREMAN . . .

Dear Mr. Molder:

Here is the 711th IMS Heater to come off my lathe -- for a 45-ounce Watson down at Amos Molded Plastics. To date I've repaired about 130 heaters and seen plenty of standard design cylinders sent to our shop so we can get mounting details off of them. So I think you'll agree that I know something about heating cylinders.



I have been building IMS Leakproof Superheaters for nearly 9 years now, and what makes us boys in the shop feel sure that IMS Heaters are the best is that once a molder tries one, sooner or later he orders a second, and a third. As the original equipment cylinders give out, it seems they always replace with IMS Superheaters! No sense throwing good money after bad by repairing old heaters when an IMS Cylinder will give your machine a new lease on life.

From where I see it -- in the shop -- you can't do better than replace with an IMS Uniform Design Leakproof Superheater. And when you do, you know I'll personally see that it's the best cylinder that your money can buy!

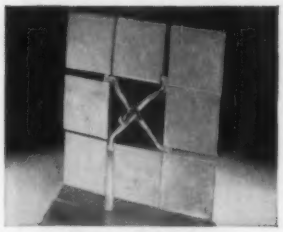
Sincerely yours,

Ray Scroeck

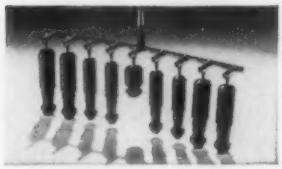
Yes, There's New Life for Old Presses with IMS Superheaters

INJECTION MOLDERS SUPPLY COMPANY
3514 LEE ROAD • WYoming 1-1424 • CLEVELAND 20, OHIO

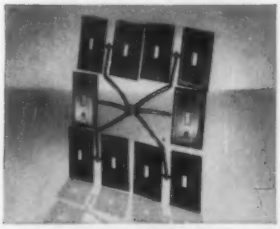
How Does Your 12 oz. Compare?



8 cavity tile mold,
4¼ x 4¼, 4 shots / min.



9 cavity shot, screwdriver handles



10 cavity, electrical wall
switch plate mold



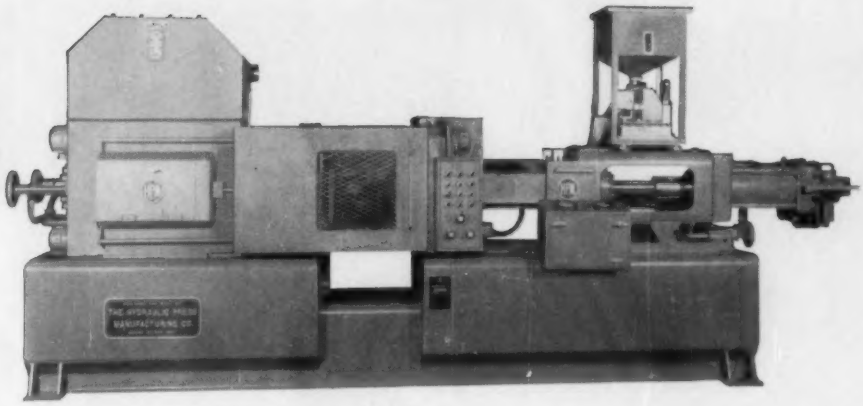
19 oz. butyrate
10 cavity heel mold



14½ oz. polyethylene dishpan



15 oz. shot radio
cabinet



Check These SPECS for the H-P-M "12" -The Hottest Machine on the Market

DAYLIGHT	30"
STROKE	20"
PLATEN SIZE	30" x 33"
MAX. MOLD SPACE	20" x 30"
PLASTICIZING CAPACITY	135 lbs. general purpose polystyrene
INJECTION SPEED	1150 cu. in. / min.
ELECTRIC MOTOR	40 hp

Look at the typical H-P-M 12 oz. injection molding machine jobs at the left. 19 oz. shots . . . 14½ oz. shots . . . multiple cavity molds . . . large projected areas . . . you name it—the H-P-M 12 oz. has the "heart" for full capacity punishment and then some. There's no equal for output—a real money-maker for the large expanding plastic market. Make sure you get all the facts today. Send for complete information.

HPM

THE HYDRAULIC PRESS MFG. CO.
Mount Gilead, Ohio, U.S.A.
A DIVISION OF KOEHRING COMPANY

REINFORCEMENT News from L·O·F GLASS FIBERS COMPANY



L·O·F Glass Fibers' Garan roving being chopped and blown into a flocking-type preform machine at Structural Fibers, Inc., Bedford, Ohio.

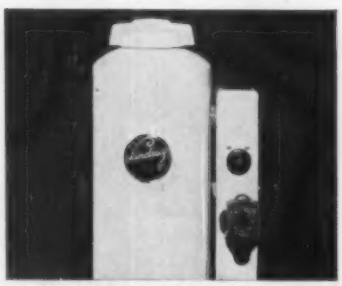
Lindsay Water-Softener domes . . reinforced with Garan® roving for high wet-strength retention!

Mr. Thomas Harris, manager, Matched Metal Molding Division, Structural Fibers, Inc., says: "We selected Garan roving for preforming water-softener domes to the exacting specifications of the Lindsay Company. Garan roving's superior wetting-out properties helped us mold a dome with extremely high wet-strength retention!"

Exclusive with L·O·F Glass Fibers Company, Garan roving has many important advantages . . .

- Improves flexural, compressive and tensile strength!
- Wets out rapidly, thus speeding up molding cycle!
- Bonds more uniformly with polyester molding resins!
- Allows maximum translucency, with minimum fiber-pattern!

Vitron roving is available for many molding applications with epoxy, silicone and polyester resins. For technical advice on how Garan or Vitron roving can improve your product, call our nearest sales office, or write: L·O·F Glass Fibers Company, Dept. 15-106, 1810 Madison Avenue, Toledo 1, Ohio.



The Lindsay Company's new water softener has a superior plastic dome reinforced with Garan roving.

L·O·F GLASS FIBERS Garan ROVING

L·O·F GLASS FIBERS COMPANY

TOLEDO 1, OHIO

Makers of glass fibers by the "Electronic-Extrusion" process



PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

To get dimensional accuracy you can count on...



count on **Plenco**

THE SHUTTER winks. In the interval, a panorama of surging action may be imprisoned within the camera housing. Plenco's phenolic engineers work with the knowledge that the precision operation of cameras, digital computers and other delicate instruments reflect the accuracy of their production. Plenco phenolic molding compounds have been developed and proved for this purpose. Their dimensional accuracy is but one of the excellent properties you can count on with Plenco.

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

Light but tough!

modern protection based on

WELKOTE



This 10′ x 14′ Welkote-based tarp is an easy load for one man.

Welkote is at the very heart of the big change in protective coverings. On trucks and railroads, on playing fields, construction sites and oil fields . . . wherever dependable, lightweight protection is needed, you find more and more tarpaulins, tents and covers based on this Wellington Sears base fabric for neoprene and vinyl coatings.

Tough filament nylon Welkote teams up perfectly with vinyl and neoprene because it was specifically engineered for them. The finished Welkote-based product, when properly coated and fabricated, is amazingly light, yet strong beyond belief. Its remarkable tear strength and resistance to water, wear and weather, are already setting new long-term economy standards in many industries. Further, Welkote-based materials are easier to transport and handle (see picture above).

Welkote is widely specified by coaters. Supplied by Wellington Sears in three basic weights, it is one of many fabrics we engineer for the coating industry—and one of a long list provided to all industries for over a century. This extensive experience is yours to work with in all our base fabrics, available for every coating use at Wellington Sears.

For illustrated booklet, write Dept. K-10.

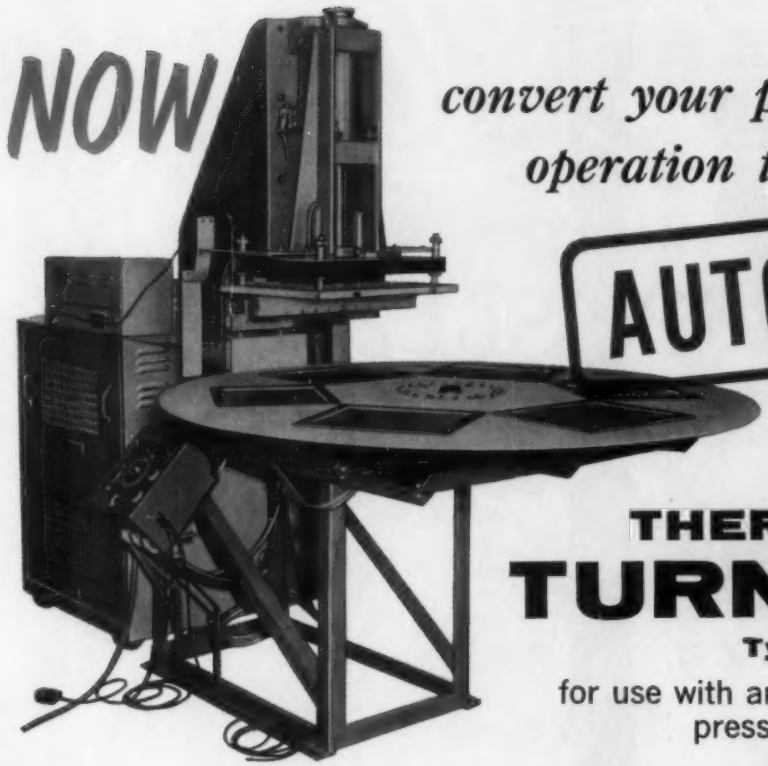
Wellington Sears

FIRST In Fabrics For Industry

For Coated Materials, High and Low Pressure Laminates and Other Reinforced Plastic Products

WEST POINT TEXTILES

Wellington Sears Co., 65 Worth St., New York 13, N. Y. • Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis



NOW *convert your plastic welding operation to complete* AUTOMATION

THERMATRON TURNTABLE

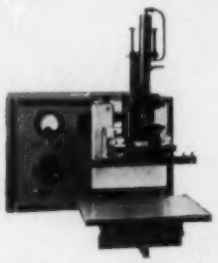
Type T-T-2

for use with any standard Thermatron press and generator

Easily attached, simple to operate, the Thermatron automatic turntable brings greatly increased speed and accuracy to electronic welding of vinyl plastics. One turntable can produce as much as two to three standard feed units, giving you important savings in floor space and equipment costs. Speed can be adjusted to match the pace of your fastest operator – Up to 30 welds per minute are possible. Every weld is exact and uniform–no rejects or spoiled work–and actual labor costs are reduced.

The Thermatron turntable is adjustable for 4, 6, 8, 12 and 24 indexes per revolution, with the entire operation controlled by an electronic brain. Errors can't occur because automatic safety features control every step of the process.

Our engineers will be glad to show you how this automatic turntable can benefit your production. For complete details, write today to Dept. 109.



Thermatron generators and presses for electronic welding of vinyl plastics are available in a wide range of sizes from ½ to 500 KW, suitable for every type of operation. Let us supply information on Thermatron equipment for your particular requirements.

Thermatron Division

RADIO RECEPTOR COMPANY, INC.

Radio and Electronic Products Since 1922

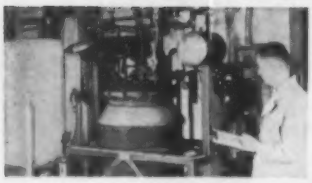
Thermatron®

HIGH FREQUENCY SEALING AND HEATING EQUIPMENT

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go straight

to the polyester resin specialists!

Take your polyester resin needs straight to the one source that makes them *exclusively*. As America's largest producer of government specified synthetic resins, our entire plant is devoted to research and production of these materials. Our capacity is as flexible as your needs. We can handle 1,000 pounds or 30 million pounds with the same ease, the same individual care, the same follow-thru. Concentrating on one job makes possible a custom kind of service that has paid off in an impressive list of American Alkyd customers. They appreciate the extra *service*, the extra *assistance*, the extra *quality* and the shortage of red tape! Send for *free* "Fact File" on polyester resins.



Manufacturers of Synthetic Resins . . . Reactive, General Purpose, Light Stabilized, Thexotropic, Flexible, Fire Retardant, Gel Coat.

For complete information, call the President

AMERICAN ALKYD INDUSTRIES

Broad and 14th Streets, Carlstadt, N. J. • Geneva 8-4332



Hartig 4½" Extra Long Extruder

HARTIG EXTRUDERS

Designed for Today's Needs...

and Tomorrow's

Heat On Barrel: 14 bands at 2500 watts each
4 Control Zones on barrel and 1 on die head
5 Temperature Controls (proportioning type)
Effective Length of Screw: 93½"
Thrust Bearing Capacity: 221,900 pounds (at 60 rpm)
Floor Dimensions: 138" x 70" (belt drive machine)
Approx. Weight: 6000 pounds
Nominal Capacity: 300-350 pounds per hour
Motor Drive: 40 to 60 HP
(direct or V belt drive optional)

Extruders from 1¼" through 12" bore | Standard 15:1 L/D | Extra Long 21:1 L/D

HARTIG EXTRUDERS

ESTABLISHED 1890
448 HILLSIDE AVENUE, HILLSIDE, NEW JERSEY
Chicago Representative:
C. J. BERINGER, 727 ECHO LANE, GLENVIEW, ILLINOIS

Send for your copy of the new booklet describing the complete line of Hartig Extruders.





Angier Cement specified to join Formica to steel

by Youngstown Kitchens

FOR THAT NEW HOME LOOK



By means of an automatic reciprocating spray gun, Youngstown quickly coats Formica and steel with Angier's reinforced Neoprene Cement. The steel is then heated to about 300°F. and the Formica to 180 - 190°F. At this point, the materials are combined for a permanent bond.

Without a doubt, Youngstown Kitchens are the world's best known kitchens. And cabinet tops of beauty-bonded Formica are one important reason why.

The colorful Formica surface, resistant to stain and marring, is a "dream come true" for every woman. Nothing must weaken this important feature!

That's why we are particularly proud to have an Angier Cement chosen for *sure results* in Youngstown's beauty-bond of Formica and steel.

This year, Angier Adhesives celebrates its 25th Anniversary of custom service in the solving of bonding, coating and sealing needs. Save time and money by calling on Angier experience.

ANGIER ADHESIVES

For Every Industry

Latest developments in Adhesives for
Honeycomb Construction, Vinyl Film Bonding
Rubber, Latex and Resin Cements
Pressure Sensitive Cements, Flocking Cements
Laminants and Sealants
Tie Coats Resin Emulsions

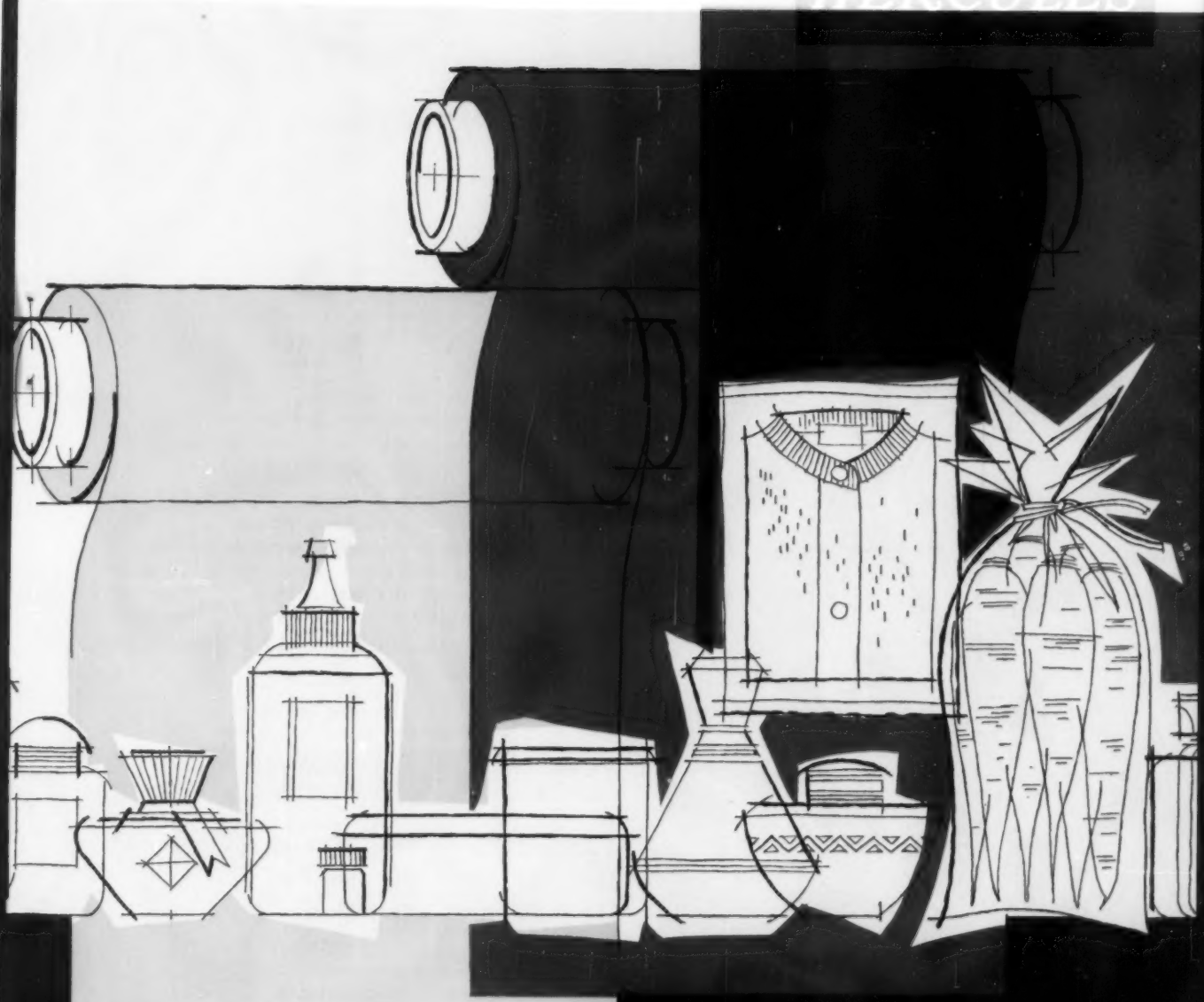
Write Dept. A for Free Descriptive Brochure

Angier Adhesives

Division of Interchemical Corporation

120 POTTER STREET, CAMBRIDGE 42, MASS.
Midwestern Plant: Huntington, Indiana

HERCULES



hi-lites on hi-fax (TRADEMARK)

and other Hercules plastics for packaging

For creative packaging at its best, Hi-fax —the truly modern plastic—offers a combination of properties unmatched by any material previously available. For more information on this versatile new ethylene polymer and other Hercules plastics developments, turn the page.

over

HERCULES POWDER COMPANY



HERCULES

quality packaging at lower cost with

hi-fax

Hi-fax provides a versatile new plastic for all types of packaging with important properties never before combined in any low-cost material:

- **Greater tear strength**
- **Greater resistance to stress cracking**
- **Lower moisture vapor transmission**
- **Selective gas permeability—foods stay fresh far longer.**

Hi-fax also offers resistance to a wider variety of chemicals and temperatures than any other low-cost material. It can be medically sterilized, and is acceptable for direct contact with food products.

Let Hi-fax solve your packaging problems now!

Regular quantities for limited production runs are now available.



HERCOCEL® FOR VACUUM FORMING

Vacuum-formed packages made with extrusion grade Hercocel combine durability and ease of production with all the recognized advantages of transparent containers. Hercocel offers excellent transparency in a full range of colors, good formability for intricate shaping jobs, plus, of course, the famed toughness and strength of acetate.

Extruder: Midwest Plastics Products, Chicago, Ill. Vacuum-formed and manufactured by J. B. Carroll Co., Chicago, Ill., for Atlantic Fish and Oyster Co.

TRANSPARENT TOUGHNESS IN MOLDED PACKAGES

The cartridge housing for the new Swingline industrial stapler has to be tough and sturdy to withstand hard day-after-day use. Hercocel gives it the rugged strength it needs. For transparent toughness in molded packaging, specify Hercocel.

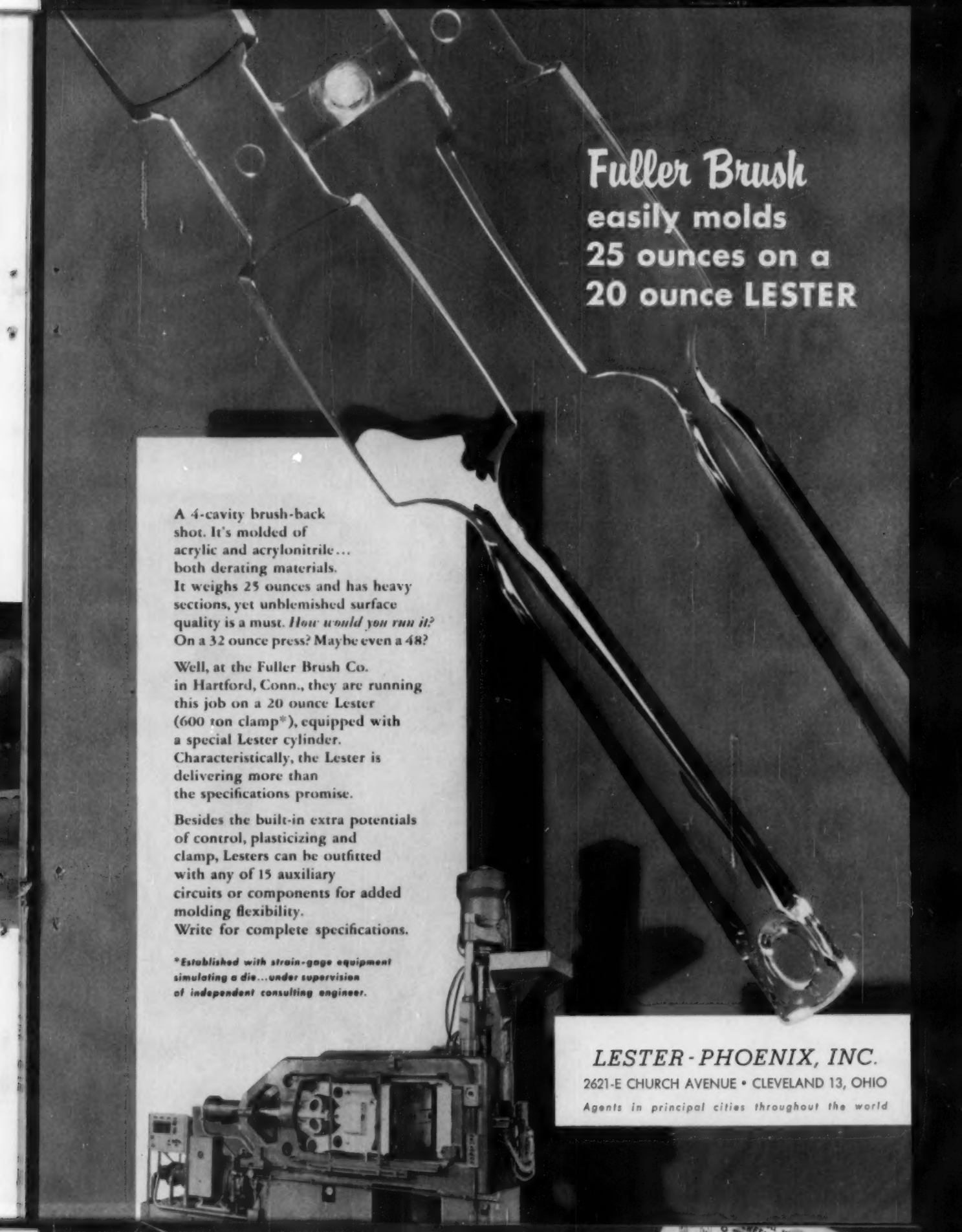
Molded with Hercocel for Swingline, Inc., Long Island City, New York, by Laurel Plastics Corporation, Wannemassa, New Jersey.



Cellulose Products Department

HERCULES POWDER COMPANY
INCORPORATED

916 Market Street, Wilmington 99, Delaware



Fuller Brush easily molds 25 ounces on a 20 ounce LESTER

A 4-cavity brush-back shot. It's molded of acrylic and acrylonitrile... both derating materials. It weighs 25 ounces and has heavy sections, yet unblemished surface quality is a must. *How would you run it?* On a 32 ounce press? Maybe even a 48?

Well, at the Fuller Brush Co. in Hartford, Conn., they are running this job on a 20 ounce Lester (600 ton clamp*), equipped with a special Lester cylinder. Characteristically, the Lester is delivering more than the specifications promise.

Besides the built-in extra potentials of control, plasticizing and clamp, Lesters can be outfitted with any of 15 auxiliary circuits or components for added molding flexibility. Write for complete specifications.

**Established with strain-gage equipment simulating a die...under supervision of independent consulting engineer.*

LESTER-PHOENIX, INC.

2621-E CHURCH AVENUE • CLEVELAND 13, OHIO

Agents in principal cities throughout the world

Chicago, Ill., for Atlantic Fish and Oyster Co.

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Vacuum-Forming . . .

with Celanese Acetate Sheeting

the packaging method with practical answers to:

- **shelf life**
- **appearance**
- **selling power**
- **product protection**
- **multi-parts organization**



VACUUM-FORMING with sparkling transparent Celanese Acetate sheet can fit your product like a glove and can fit your merchandising plans equally as well and boost sales to new highs!

As skin packs, blister cards, compartmented containers and transparent boxes, vacuum-forming offers many advantages that are not obtainable with any other packaging method. It is ideal for self-service merchandise, where it wins valuable counter display space . . . for protection of fragile contents . . . for visual organization of multi-parts contents.

Can your product benefit from this sure-fire packaging method? Get the facts about vacuum-forming from the Celanese Product Development Department before deciding. They can bring you up to date on the latest developments . . . give you cost estimates . . . put you in touch with the fabricators. Just mail coupon below.

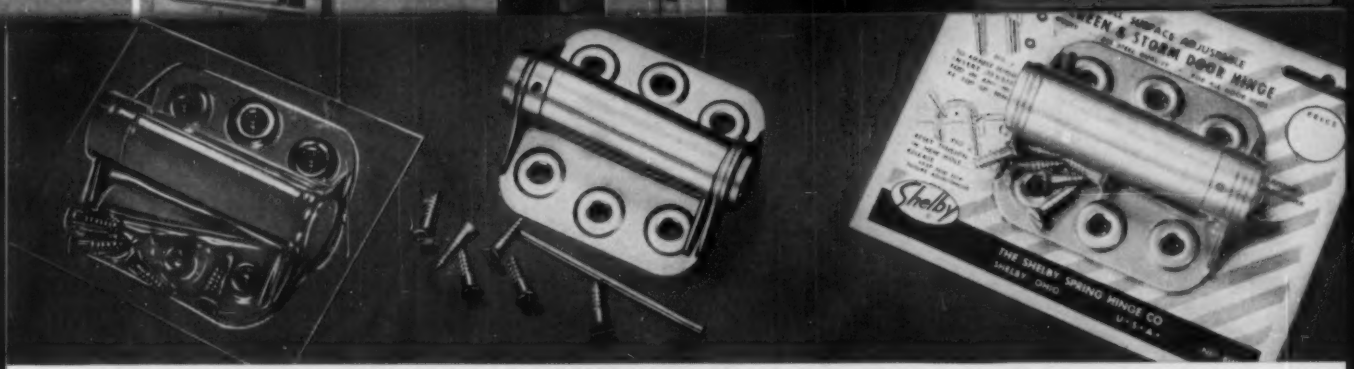
Celanese Corporation of America, Plastics Division, Dept. 101-J 290 Ferry Street, Newark 5, N. J. Canadian affiliate: Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver. Export sales: Amcel Company, Inc. and Pan Amcel Company, Inc., 180 Madison Avenue, New York 16, N. Y.

Celanese®

Celanese plastics

COCKTAIL SET
Plaxall, Inc.,
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forms package and dividers, designed by Raymond Loewy and Associates, for Fostoria.





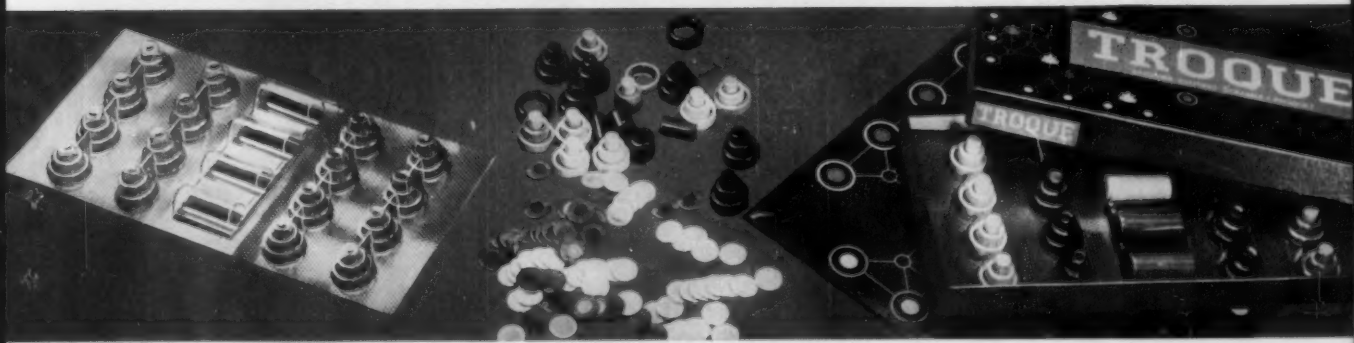
Blister Package by the Shelby Spring Hinge Co., Shelby, Ohio



Avon demonstrator package by F. N. Burt Company, Inc., Buffalo, N. Y.



Wearever ball pen and refill dome package by Utility Printing Co., New York City, N. Y.



Compartment overlay for Production and Marketing Co., Newton, Conn., by Duraplastics Inc., Bridgeport, Conn.

Celanese Corporation of America, Plastics Division, Dept. 101-J
290 Ferry Street, Newark 5, N. J.

Send me vacuum and pressure forming information.

☐ I am interested in packaging_____(type of product).

☐ I am interested in formed displays. ☐ I am interested in forming machinery.

NAME_____

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Dake Plastics Presses Are

Job Engineered...

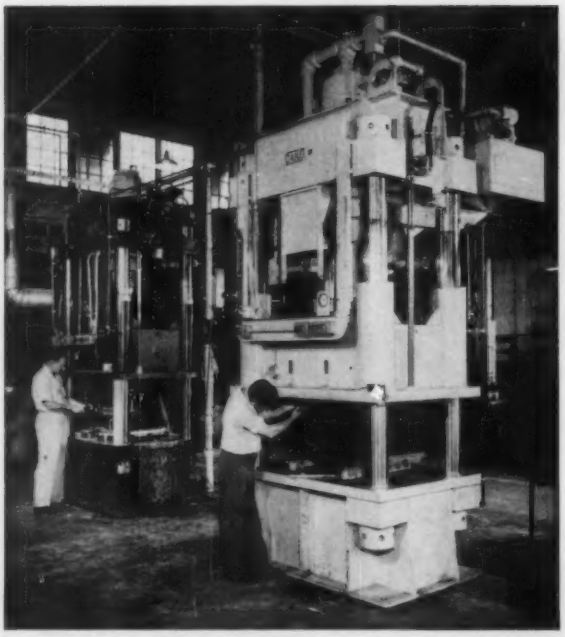
for

BETTER QUALITY
FASTER PRODUCTION
LOWER COSTS

DAKE PRESSES for Molding Reinforced Plastics are job engineered to assure more efficient production . . . the key to more profitable production in this rapidly expanding industry. Dake enables you to meet the exacting requirements of modern molding techniques for highest product quality at lower cost.

Advance and closing speeds, pressure, temperature, and curing time are engineered to meet individual job specifications. Dake Presses are semi-automatic for accurate control throughout the entire curing cycle, and rigidly constructed to hold precise dimensions day after day, month after month.

To assure higher production schedules and consistent quality, let Dake design a *job engineered* press for your individual requirements. Write today for Bulletin 340, and tell us of your particular problems.



These are two of three Dake Plastics Molding Presses built for a large refrigerator manufacturer. The newest (right) incorporates features that were not considered necessary when the first press was built only 30 months earlier. Thus Dake engineering copes with the rapid advances now being made in the plastics molding industry.

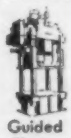
DAKE CORPORATION, 648 Seventh St., Grand Haven, Mich.

DAKE PRESSES


Arbor Presses


Hand-Operated Hydraulic


Power-Operated Hydraulic

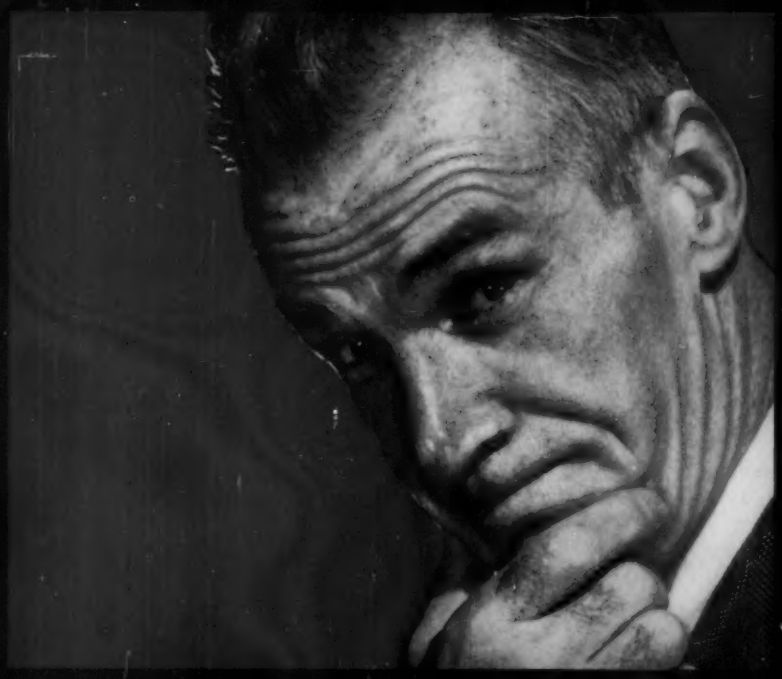

Guided Platen


Gap Type Presses


Movable Frame

COMPANY NAME

ADDRESS



A REAL-LIFE MOLDING PROBLEM

And how it was Solved!

The molder furrowed his brow at the rigid specifications in his order for interlocking styrene cases. The cases would have to withstand unusually heavy abuse . . . be molded to exceptionally close tolerances . . . assure trouble-free production.

Foster Grant was called in, recommended a Fostarene formulation especially suited to the problem.

In production, Fostarene molded easily, reduced costly rejects to a minimum, scoffed at abuse. Happy ending to a tough assignment.

Foster Grant has been solving molding problems for over 30 years. You name the problem . . . chances are Foster Grant has licked it with

FOSTARENE

VIRGIN POLYSTYRENE · *general-purpose · high impact · high flow*

AVAILABLE IN PELLETS, GRANULES AND FINE GRIND FOR DRY COLORING . . . IN CRYSTAL CLEAR AND A FULL RANGE OF CUSTOM COLORS

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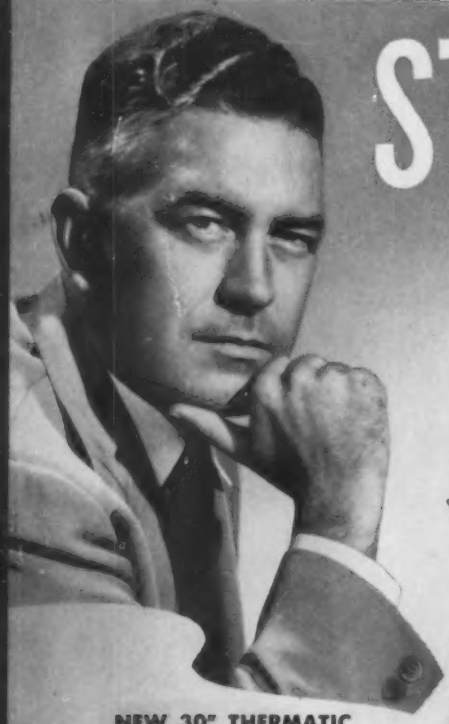
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A PIONEER IN PLASTICS FOR OVER THIRTY YEARS

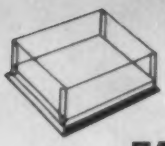


STOP and THINK

. . . and you'll buy

Taber

SHEET PLASTIC FABRICATING EQUIPMENT





SAVE LABOR! SAVE MATERIAL! Taber equipment is so precisely engineered that rejects are reduced to the bare minimum . . . thus saving you countless dollars in wasted materials. In addition, the higher production speeds and many exclusive automatic features of Taber equipment creates substantial savings in labor. So . . . STOP and THINK! Don't you owe it to yourself to get all the facts on Taber *before* you buy?

NEW 30" THERMATIC FOLDER, MODEL 178

A dual purpose machine; makes U-type, 180° folds similar to the "Model 103 Thermofolder" but has a longer blade permitting the folding of material up to 30" in width. Requires small amount of compressed air. Can be set up and used as a creaser by changing the blade and moving a toggle switch to the "off" position which renders the actuated power pinch-bar inoperative.





CONTINUOUS TYPE FOLDER, MODEL 172

Designed to make double-fold card protectors and wallet inserts up to 3" wide and 12" in length. Capacity — .003" to .010" transparent thermoplastic roll material. Features adjustable electric cut-off for automatic operation.

18" THERMOFOLDER, MODEL 103

Forms U-type, 180° folds, with sides tight together or opening up to 7/64". Provides controlled folding cycle that enables average operator to produce 700 or more folds per hour on material .005" to .015" thickness up to 18" wide.



DUPLEX - STRAIGHT EDGER, MODEL 144-2

Simultaneously beads both edges of cut sheets or roll material .005" to .015" in thickness with the same or different type bead shapes and is adjustable to accommodate material in widths from 2" up to 20".



Write for Illustrated Literature

TABER INSTRUMENT CORPORATION

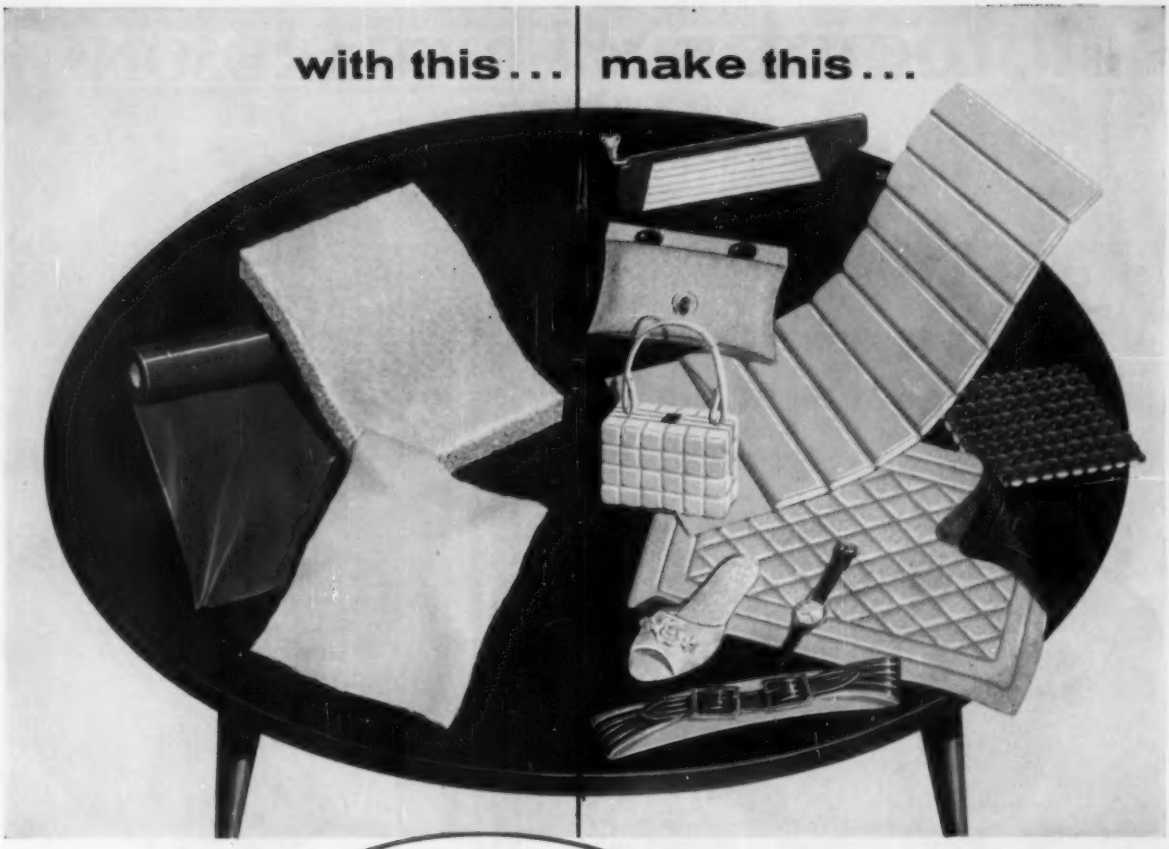
SECTION 22

111 GOUNDRY ST. • N. TONAWANDA, N. Y.

Taber also produces:

- 8" Thermatic Drawpress, Model 146
- 8" Thermatic Cylinder Beader, Model 147
- 8¼ Auto-Size Cylinder Fabricator, Model 138
- Plastic Forming & Drawing Press
- 30" Thermocreaser
- Single Straight Edger

Taber ®



now truly HEAT SEALABLE foam . . . VINYL foam

and suddenly 1000 great ideas are possible!

Development of *heat-sealable* Vinyl-foam, makes new quality, new ideas possible in hundreds of products that require cushioning or softness, fashionably molded contours, eccentric or specially-designed shapes, quick-quilted and embossed surfaces.

In all these ideas, quality is maintained. Electronic heat-sealing affects none of Vinylfoam's many desirable properties.

Exon 654, vinyl plastisol resin helps make Vinylfoam unusually resistant to abrasion, corrosion, flame, aging, moisture, tearing and chemical action. Prevents shrinking, oxidizing, hardening or drying out, all with maximum dimensional stability.

Vinylfoam, produced by the Elastomer Process, can be molded in either cored or uncored form, with or without surface contours. It can be embossed, die cut, split or skived. You can bond Vinylfoam directly onto textiles, most synthetics, and on vinyl sheeting or film in continuous lengths.

Vinylfoam is so versatile that products in almost every industry can acquire new comfort, safety and durability. And with vinyl's economy, they will cost less, sell better.

because it's made of **Firestone**

EXON

VERSATILE VINYL RESINS

engineered answers to industry's needs

Firestone Plastics Company supplies only the plastisol resin . . . does not make the finished foam.

For complete information or technical service on EXON resins, industry's most complete line of versatile vinyls, call or write:

CHEMICAL SALES DIVISION

FIRESTONE PLASTICS CO., DEPT. 62N, POTTSTOWN, PA. • A DIVISION OF THE FIRESTONE TIRE & RUBBER CO.

Hotpoint SELECTS RICHARDSON

FOR THESE MOLDED PARTS . .

. . this molded plastic impeller, perfectly balanced for high speed rotation during washing, rinsing, and drying cycles, a vital part . .



. . of this Hotpoint Dishwasher



. . this molded plastic thermostat switch, an important part . . of this Hotpoint Range . . and of this Hotpoint automatic electric clothes dryer . .





Richardson know-how, based on thousands of jobs and years of experience in plastics, produced both the intricate Bakelite molded thermostat switch and the sturdy, streamlined impeller shown above. Richardson engineers, specialists in both molded and laminated plastics, will welcome the opportunity to discuss your requirements.

Send your specifications or blueprints . . find out how Richardson facilities and services can assist you. No obligation, of course.

RICHARDSON PLASTICS

LAMINATED AND MOLDED



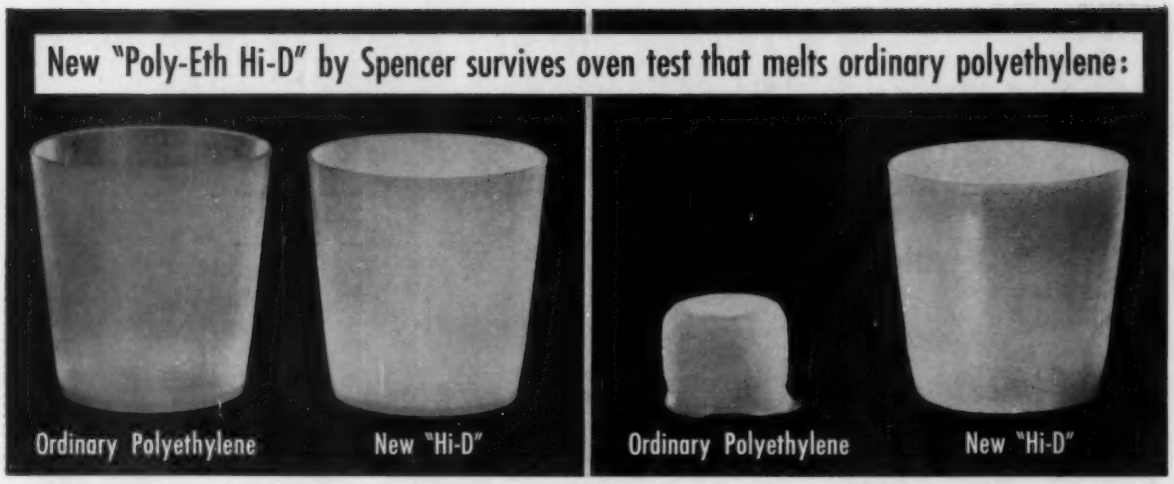
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The RICHARDSON COMPANY

FOUNDED 1858

2789 Lake St., Melrose Park, Ill. (Chicago District)

SALES OFFICES IN PRINCIPAL CITIES



(1) Before going into oven these two polyethylene cups look alike. Cup at left is made from standard polyethylene. Cup at right is Spencer Chemical Company's new high density polyethylene "Poly-Eth Hi-D."

(2) After 30 minutes at 240°F. the ordinary polyethylene cup has melted down; the "Hi-D" cup has retained its shape. This means you can use "Hi-D" for products subject to temperatures of boiling water and higher.

Spencer Chemical Company leads the industry with

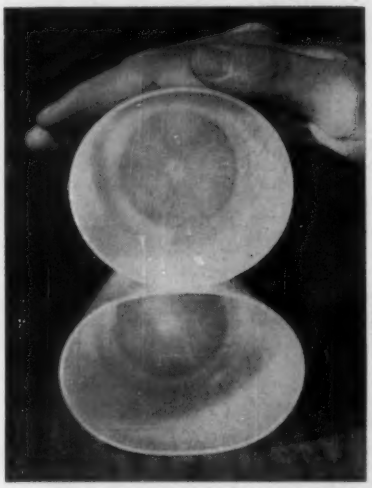
New Hi-Density "Poly-Eth" In Commercial Quantities

Countless new uses for polyethylene have been made possible by Spencer Chemical Company's introduction of a new high density polyethylene molding resin produced in a high-pressure type plant. Developed by Spencer's own staff, this new resin, trademarked "Poly-Eth Hi-D," has a density ranging from .935 to .940, and is non-toxic and odorless. Spencer is the first domestic producer to offer resins in this high density in commercial quantities.

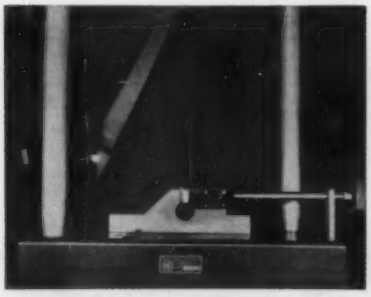
Here are just a few of the unique properties of "Poly-Eth Hi-D" compared with standard or intermediate density polyethylene: (1) Higher heat resistance — easily withstands boiling water without deformation; (2) Improved stiffness and rigidity—permits, in some cases, a money-saving reduction in wall thickness without loss in strength; (3) Less permeable.

Faster cycling periods should be possible with "Poly-Eth Hi-D," since these resins can be taken from the mold at higher temperature. And products molded from "Poly-Eth Hi-D" will have improved resistance to surface abrasion.

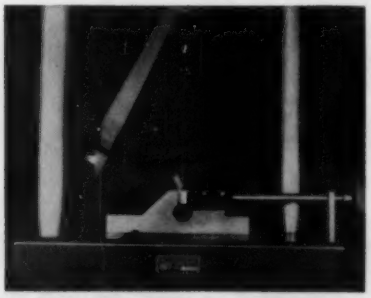
Only Spencer offers you commercial quantities of this new polyethylene. So for more information, contact your nearest Spencer sales representative, or write Spencer Chemical Company for a "Poly-Eth Hi-D" data sheet.



(3) New "Hi-D" (top) is stiffer, too, than standard polyethylene (bottom cup). Yet "Poly-Eth Hi-D" has the same fine impact properties associated with conventional polyethylenes.



(4) Low-pressure type polyethylene snaps after impact with pendulum hammer in Izod notched impact test. The broken half is at the extreme left in this high-speed photograph.



(5) "Hi-D" withstands this same severe test. The sample has not broken and is rebounding into normal position. Think of the ways you could use this new polyethylene.



SPENCER CHEMICAL COMPANY
Dwight Bldg., Kansas City 5, Mo.

ANNOUNCING SPENCER NYLON

Spencer Nylon brings you the most highly controlled specifications and highest melt viscosity of any nylon on the market... PLUS many new-product possibilities:

You may soon be using a new nylon in ways that neither old-type nylon nor any other plastic could ever be used before. Manufactured by continuous polymerization instead of by the old-fashioned "batch" process, Spencer Nylon has the most highly-controlled specifications of any nylon available today.

You can depend on Spencer Nylon for many new products not possible with "batch"-manufactured nylon. And, of course, many processors are already finding they can improve their present nylon products by using this new nylon.

Spencer Nylon has the highest melt viscosity of any commercially-available nylon. Because Spencer Nylon has more body when melted this means that for the first time you have a nylon well-suited for extruding pipe and film, and for blowing bottles.

Utilizing special techniques, available through Spencer's technical assistance, this new-type Spencer Nylon can be made into larger void-free parts than have previously been possible with other types of nylon resin.

Offering you profit opportunities by the dozen, Spencer Nylon should now be considered for use in any product where strength, impact resistance, lightness and extra durability are important.

HOW SPENCER PLANS TO GIVE YOU MARKETING INFORMATION AND HELP:

If you are looking for ways to improve a present product, or if you are planning to introduce a new product, Spencer will be happy to discuss with you the many ways in which the unique properties of Spencer Nylon may best be utilized.

Also, Spencer can show you many consumer needs not being adequately met by present products or materials. And Spencer may be able to help you expand into profitable new fields through the use of Spencer Nylon.

WHEN SPENCER NYLON WILL BE AVAILABLE

Spencer's multi-million pound plant, now under construction in Henderson, Kentucky, will be ready next year to supply you with Spencer Nylon. Spencer Nylon will be manufactured under licensing agreement with Algemene Kunstzijde Unie N. V. (AKU) of Arnhem, Holland, the distinguished international corporation with extensive experience in plastics and textiles.

In the meantime, to meet existing demands, Spencer is ready right now to bring you AKU-manufactured shipments of this same superior nylon in eight grades. For further information write or wire: Spencer Nylon, Spencer Chemical Company, Dwight Bldg., Kansas City 5, Mo.

NOW! NYLON *by* SPENCER

SPENCER

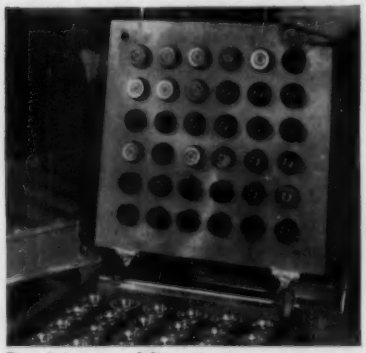
SPENCER CHEMICAL COMPANY

GENERAL OFFICES: DWIGHT BUILDING, KANSAS CITY 5, MISSOURI

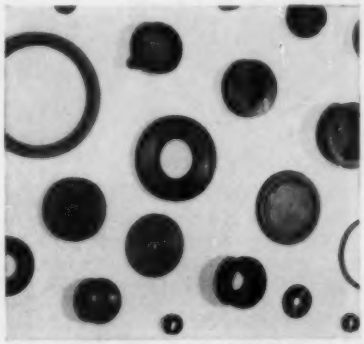




Laboratory and service tests check compound resistance to oils, fuels and chemicals at high and low temperatures . . . assuring the long life of Parker O-rings.



Precision molding by exclusive, automatically controlled methods assures close-tolerance fits. Parker has molds for 296 *standard* O-ring sizes. Send for data.



Whatever your spec on service, shape, tolerance, surface smoothness . . . one of Parker's special rubber compounds can be custom molded to meet the need.

Compare actual O-ring samples

Prove by comparison tests how Parker O-rings seal better and last longer

For trouble-free leakproof sealing, you can depend on Parker O-rings. They are precision molded of superior compounds that have been developed as the result of thousands of tests.

Elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals, and high and low temperatures, are determined with care. Then, laboratory and service tests make sure that all rated characteristics are held.

From Parker you can get exactly the *right* O-ring for your *specific* application. We invite you to compare Parker O-rings with any other make. Our engineering service will also help you with designing problems.

Send for complete engineering data today. Mail the coupon for your *free* data book or ask your Parker O-ring distributor for a copy.

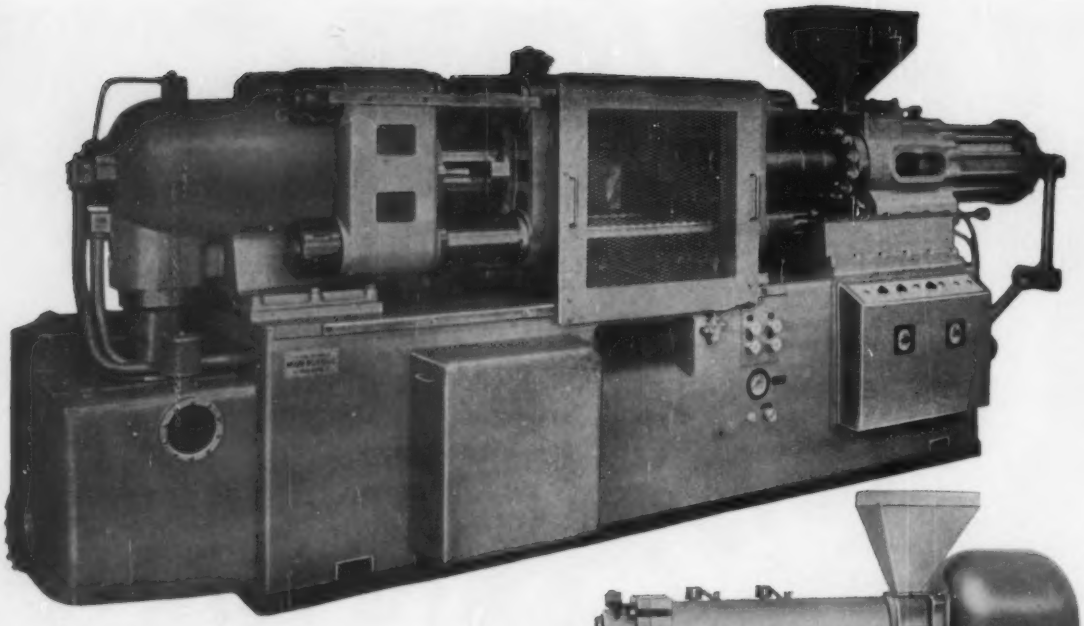
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These machines mean BUSINESS--for you

Inside each of these smoothly-finished housings is an efficient plastics machine, built to deliver long and profitable service. These are just a few in the extensive line of extruders, injection presses and vacuum formers built by Negri Bossi, a great name in plastics processing equipment.

INJECTION PRESSES—Negri Bossi injection presses, like the NB 360/520 shown here, can be set up almost anywhere because they get their operating pressures from a built-in oil-hydraulic drive that needs only electricity to operate. The new-design electrical system makes service and operation simplicity itself. Service of the cylinder, screw, nozzle and heaters is also simple; they can be removed as a unit by just one person. The operator is protected by an automatic device that prevents operation when the safety gate is open. Automation is a built-in feature of Negri Bossi presses; simply by shifting a lever, the operator can choose semi-automatic or fully-automatic cycling.

EXTRUDERS—Negri Bossi single screw extruders are available in models with 30mm, 45mm, and 60mm screw diameters (Types T/30, T/45 and T/60). Screws are made in a wide variety of designs out of a special chrome-hardened steel. Among the types of die heads available are those for making tubing and profiles, for coating wire and for blowing tubular sheeting. Ball bearings are used throughout the extruders at all points of friction. A built-in cooling system circulates water through the entire machine.

Negri Bossi also makes a full line of extruder take-off equipment.

VACUUM FORMERS—Here is something *really* sensational! Negri Bossi introduces vacuum formers with patented movable, variable infra-red heaters that concentrate heat where it is most needed, assuring constant cross-sections throughout formed pieces and permitting extremely deep draws. Negri Bossi also manufactures a low-cost model for laboratory and test-run use, and a high-output machine with two 25⅝" by 35⅝" stations.

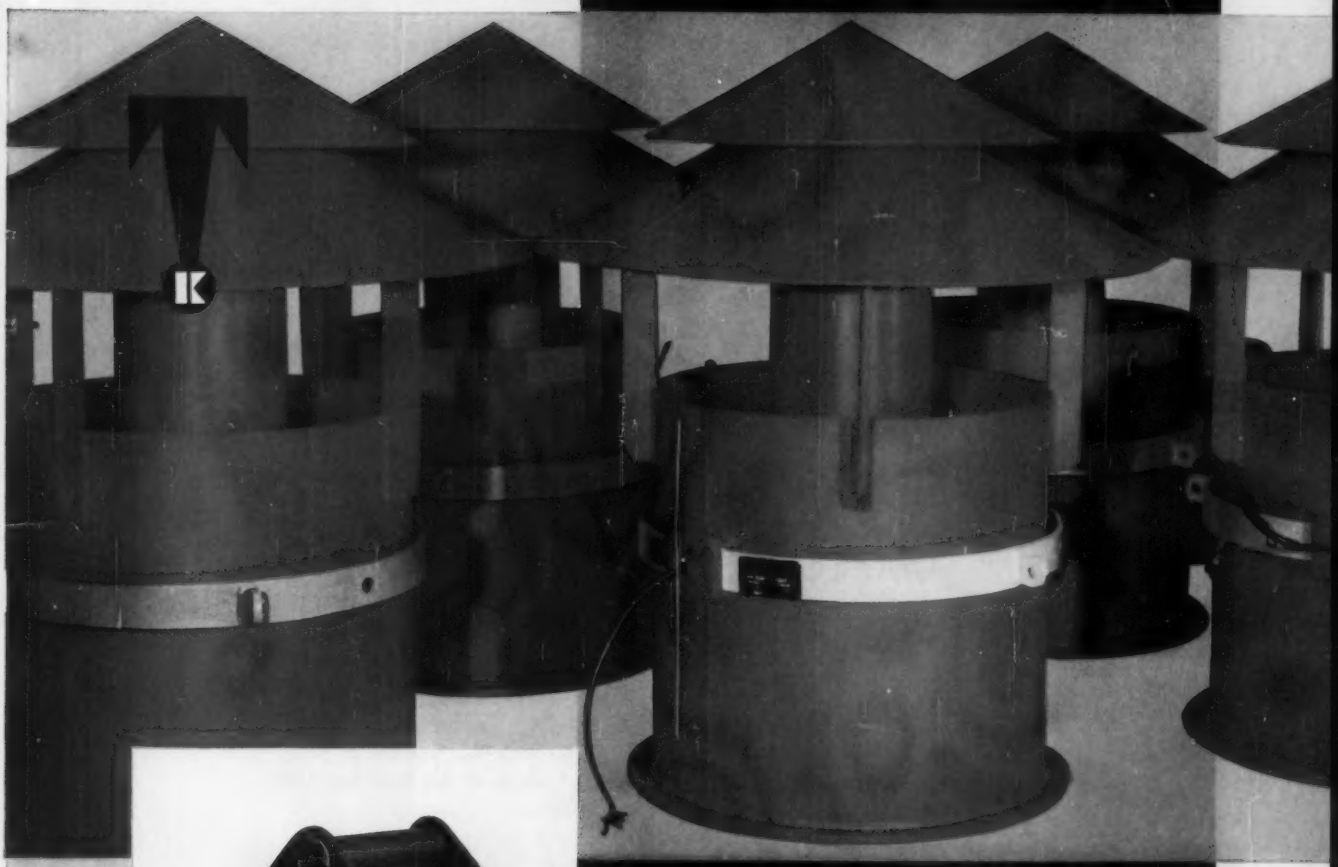
Write for detailed information on machinery made by Negri Bossi, one of the world's largest manufacturers of plastics processing equipment.

Sole distributors in the U. S. A. **ACME MACHINERY & MANUFACTURING CO., INC.**
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Corso Magenta, 44 — Cable address: "Gianimar"

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TROVIDUR has become an indispensable material for the manufacture of Tube conduits, Apparatus, and other Installations of the chemical and related industries. However, the development of our TROVIDUR and the exploration of new fields for its application have not yet come to an end. The use of the corrosionsproof, easily and accurately workable, non-conducting TROVIDUR will make it possible to produce more economic and attractive implements than heretofore in many other lines of industry.

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You get purity and uniformity and economy, too— when you buy solvents from Shell Chemical

WHEN YOU STANDARDIZE on solvents from Shell Chemical, three advantages are yours!

- You know *exactly* what is going into the blends you make, because Shell solvents are pure products that meet or exceed the highest industrial standards for purity and uniformity.
- Shell solvents are based on stable sources of basic raw materials, assuring dependability of supply.
- You can call on Shell's technical service staff to help you make your product a *better* product—at lower cost.

Next time you're ready to order solvents, check with Shell Chemical. Find out how you can save money through multi-product shipments in tank cars or tank trucks. Prompt delivery is assured from conveniently located storage facilities. Write for specifications and quotations.

Shell Chemical is your dependable source of—

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Methyl Ethyl Ketone
Methyl Isobutyl Ketone
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The Plastiscope*

October 1956

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Polystyrene price decline. The price for general-purpose crystal polystyrene dropped 2½¢ a lb. just as this issue went to press. The former price was 30½ cents. Prices of other styrene-type molding materials are being altered, and there may be more changes before this article is printed.

Speculation is rampant on the cause for this sudden drop, especially in view of the 1½¢ rise just a few months ago. One thought is that this move is connected with a proposed plan which would have the chemical companies offering the rubber companies long-term contracts for large-volume sales of styrene monomer at several cents less than the current 16¢ price for rubber-grade monomer. The latter has always been 4 or 5¢ lower than the more refined monomer required for plastics. But if such a contract between the rubber and chemical companies were to be made, the effective date would supposedly be not earlier than mid-1957.

Another view is that present producers are using this method to inform a host of prospective small producers that polystyrene will be even lower priced in the future.

Still another angle is the effect of the sharp decline of polystyrene sales in June, which fell to 27 million lb. compared to 38 in May and 41 in April. June sales in 1955 were 29 million, but sales in the first five months of 1955 were generally in a 27- to 35-million lb. volume. Some persons point to the record-breaking polyethylene sales of 44 million in June as a possible clue that might indicate intensified competition with polystyrene moldings. But it isn't known how much of that polyethylene was used for molding, particularly the amount that might affect polystyrene.

It is difficult to foresee a prolonged decline in polystyrene at this time. There are too many new propositions, such as disposable containers and increased use of impact material in the offing. Perhaps the price decline should be hailed as another of the plastics industry's great sales advantages—prices coming down while everything else goes up.

Another nylon producer. Spencer Chemical Co. has announced that it will build a modest-size nylon polymerization plant at its Henderson, Ky., works. Production is scheduled to start in mid-1957. Spencer has obtained a license from AKU in Holland to produce so-called "6" type nylon in the United States. The license includes technical and application know-how. Nylon-6 is made from caprolactam and Spencer's production will be from monomer purchased in the United States. Until the plant is completed, Spencer will sell AKU nylon in the United States;

* Reg. U.S. Pat. Off.

then the company will be ready to spring eight different types of nylon-6 on the market. These include formulations for injection molding, extrusion, and blowing. Tests by Spencer indicate that its material will go to 300° F. before distortion and 420° F. before melting when heated at 66 p.s.i. pressure.

It is believed that Spencer will emphasize the use of its nylon in extrusion, for which caprolactam-type nylon is claimed to be particularly fitted because of its higher melt viscosity. It will also be pushed for large moldings because it can supposedly be molded without voids. Extruded tubing, pipe, and 12-mil sheets for blanking have been produced from nylon-6 in this country and there is no doubt that extruded film can be produced if there is a market.

Spencer's market researchers state that nylon plastic applications grew from 10 in 1949 to over 800 in 1952. No present count on number of applications is available, but consumption is believed to have grown from 610,000 lb. in 1949 to over 15 million in 1955.

Methacrylate molding material improvement. A new Lucite 140 with a heat stability that permits molding at temperatures 40° F. higher than formerly has been announced by Du Pont. The higher heat stability of the resin while in the injection cylinder permits one of three possibilities, namely: to speed up the molding cycle, fill more complicated molds, or reduce pressure to eliminate flash. Complete details are given in Section 2 of The Plastiscope, page 302.

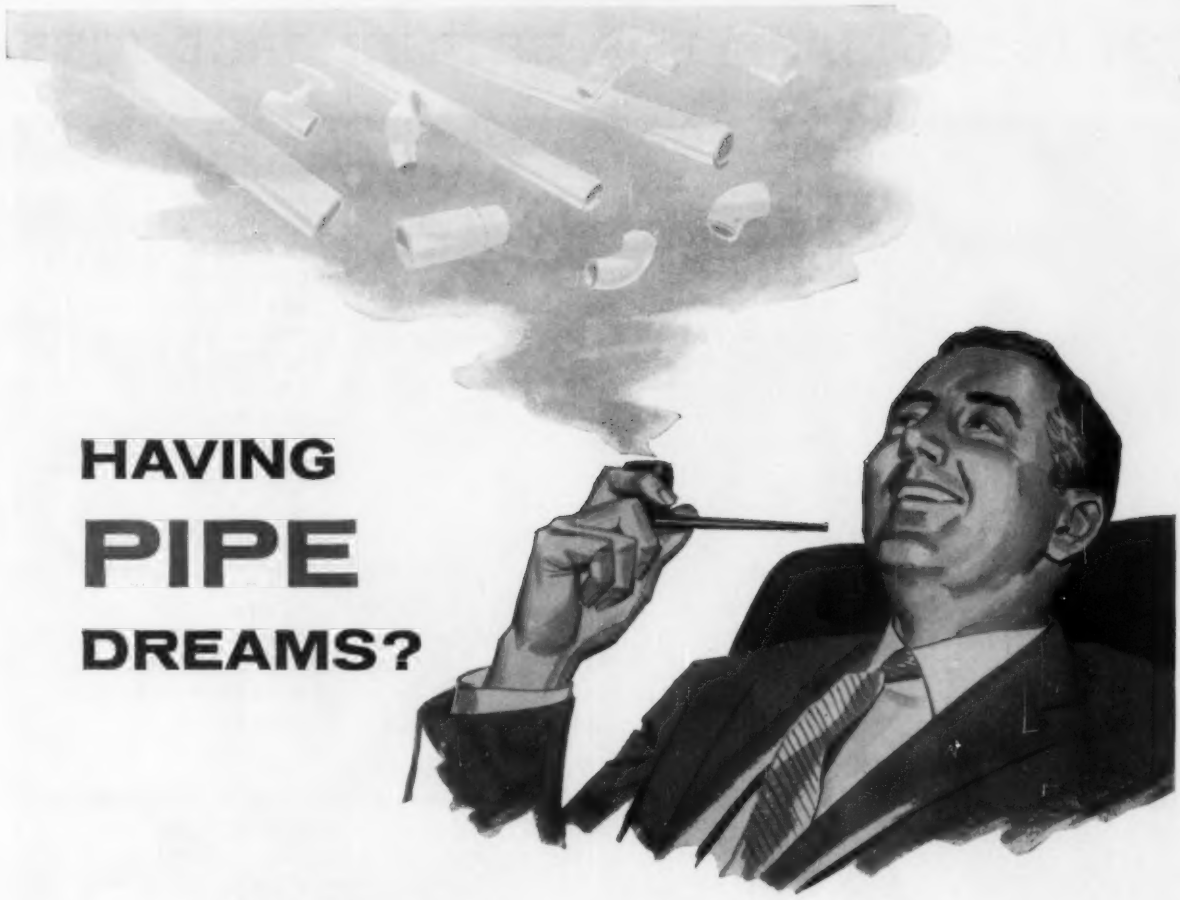
Methacrylate for reinforced plastics. At present, methacrylate monomer is not used in the reinforced plastics field, except as a small addition to some of the polyester resins to obtain better weathering properties. It competes, of course, in the form of sheet for glazing and awnings, but experimenters seem convinced that it has a future as a bonding material for fibrous glass, particularly because of its weathering and adhesive properties. In fact, its good adherence to glass was proved in the early days when it was experimentally used as the inner layer for safety glass panels.

A well informed technician offers the opinion that the monomer would be especially efficient to use with synthetic fabrics, such as Dynel, Dacron, Orlon, etc., for the formation of flexible reinforced plastics that could be easily postformed. Such a field has unlimited possibilities. Today the monomer is less than 30¢ a lb., with better prospects for a future price decline than many other materials.

Melamine licensee. Reichhold Chemicals, Inc. will manufacture melamine resins for surface coatings, adhesives, and laminates under a license agreement with American Cyanamid Co. Initially, manufacture of the product will be conducted at the firm's Elizabeth, N. J., Detroit, and San Francisco plants, with expanded production at additional plants some time in the future.

Perforated Mylar. A perforated, heat-sealable Mylar film is offered to the trade by the Plastic Film Sales Dept. of Kendall Co., 309 W. Jackson Blvd., Chicago, Ill. It is available in metallized, colored, or plain. Perforations as small as 0.020 in. and numbering from 14 to over 700 per sq. in. may be attained in film thicknesses of from 0.00025 to 0.003 in. and in a straight or staggered pattern. Widths are from 1 to 36 inches. The material is suggested for use in electrical insulation, mica bonds and laminations, filters, packaging, silk screens, and breathing

(*To page* 49)



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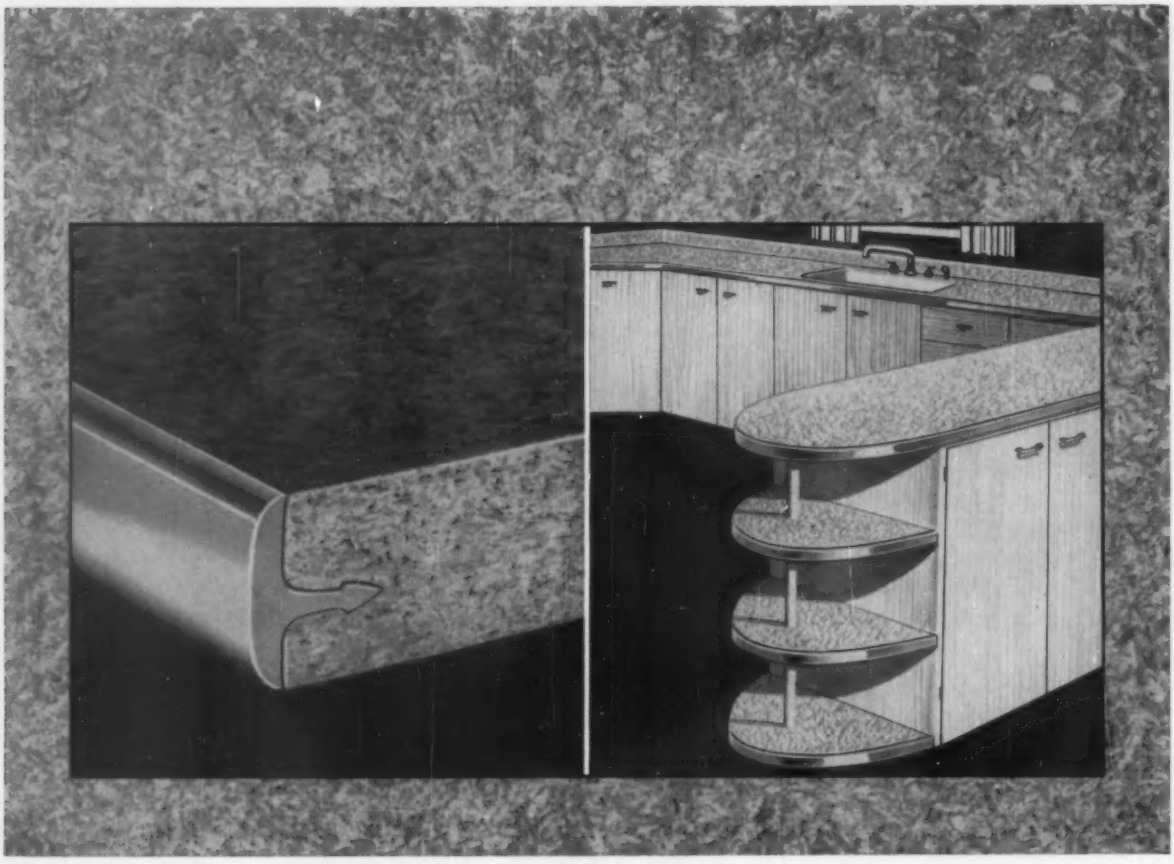
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The Plastiscope

(*Continued from p.* 46)

membranes. Kendall is working with other films in an effort to attain the same results.

Polyken tape. Another department of Kendall, Polyken Div., has just announced receipt of a contract for 4 million sq. ft. of polyethylene tape from American Pipe Line Co., which will be used to wrap 122 miles of gas pipeline for protection against corrosion.

Progress in urethane flexible foam. Estimators state that the amount of urethane flexible foam used in the United States will be running about 1½ million lb. a month in the last two or three months of this year, was about 800,000 lb. a month in mid-year, and about 200,000 in January and February 1955. Usage is expected to double about every seven months. A good portion of the above poundage is imported, but no one knows how much; various guesses put the import figure at from 15 to 45% of the total. A pick-up in the automotive industry will add to the above figures, and since Curtiss-Wright is a big producer of foam, it wouldn't be surprising to see their Studebaker and Packard cars using from 10 to 20 lb. per unit. Other car manufacturers will be using more per unit each year, too, for some time to come.

Who is making foam and what for? It is estimated that average producers of flexible urethane foam are turning out from 30,000 to 40,000 lb. a month, although there are two or three companies thought to be operating at from 100,000 to 150,000 or more lb. a month. A most interesting part of this development is speed of growth—some have grown from zero to tens of thousands of pounds in a few months, depending largely upon what field they entered. Rug underlay is a good example of this fast growth.

In addition to rug underlay, the principal markets are crash padding, furniture padding, and deep cushioning. Others with a sizable quantity but more limited market are inner linings for apparel, shoulder pads, hospital padding, X-ray body wedges, sponges, and padded abrasive disks. And furthermore, it is plainly evident that producers expect to move into heavy competition with rubber latex foam even though producers of the latter claim they can make a lighter-weight but still useful foam than the 6- or 7-lb./cu. ft. material now generally in use.

Other urethane foams. Another foam about which little is known but which has aroused considerable curiosity is that made from Du Pont's "Teracol 30" polyether resin. It is claimed to have more softness, greater freeze resistance, higher resiliency, and most important of all, greater load-carrying capacity than polyester urethane foam but will probably always be 15 to 20% higher in cost on a pound

basis. It is headed more particularly for competition with rubber latex foam than with polyester urethane, especially because of its resilience.

The polyether mentioned above is a straight polymer—might be a polymerized ethylene glycol; Du Pont doesn't say what it is. The polyester used in foam is made by the reaction of adipic acid with ethylene glycol to which a little trimethylol propane is added and then reacted with isocyanate to obtain a urethane.

The plasticized castor oil foam is lower in cost than any of the foams mentioned here, all of which require isocyanate. It is plasticized with an ester such as dibutyl sebacate. But it has a limited market and is useful primarily only for packaging and other applications where shock absorption is important. It is only 5% resilient—polyester urethane is 35 to 40% and polyether urethane is 55 to 60% resilient.

Fire damages new vinyl chloride facilities. The Fitchburg, Mass., *Sentinel* of Aug. 20, 1956 describes how an explosion of vinyl chloride monomer destroyed part of the Great American Plastics Co. plant on Aug. 19 with a "blast" that set fire to a one-story, wooden machine shop next door and spread to two nearby brick buildings. The item says that the blast was heard five miles away and shattered windows in homes within a 1000-ft. area. The fire marshal stated that the cause of the explosion was a concentration of vinyl chloride monomer vapors ignited by some source of spark or flame. Another fire chief said that apparently a pipeline ruptured. The processing plant, about 36 ft. wide, 50 ft. long, and 2 stories high was in an old mill and had been in operation about five weeks, according to the newspapers.

Correction concerning Navy pipe. There has been some misunderstanding concerning the suppliers of PVC pipe for the United States Navy's washdown job on shipboard which was mentioned in this department (p. 45, August issue). Grinnell Corp., which developed the system, obtained the original pipe, but the Navy itself is sending out invitations to bid now that the system has been perfected. The Navy specifications are MIL-P-19119 (Bureau of Ships), Nov. 8, 1955 and two amendments, No. 1, April 27, 1956 and July 2, 1956. The full story of this shipboard application starts on p. 129 of this issue.

General Tire and plastics pipe. The recent acquisition of a majority share of A. M. Byers by General Tire led President William O'Neil of General to say: "This will put Byers Co. into the plastic pipe business on a large scale . . . make Byers the largest producer and seller of plastic pipe in the world." Byers has a distribution system ready made for plastics pipe since the company is already a large producer and distributor of wrought iron pipe. Distribution is a most vital part of pipe merchandising as any plastics pipe producer can testify, and Byers will now presumably have the facilities of Carlon and Bolta for production purposes. Control of Carlon, probably the largest plastic pipe producer in existence, was reportedly sold to General a few weeks ago.

In addition to its pipe operation, General now has a vinyl monomer and polymer plant, four vinyl processing plants, a polyester resin plant, the Aerojet operation in California which uses many pounds of reinforced plastics, and a foam plant which some estimators think is the largest producer of urethane foam in the United States. For more about General, see p. 304.

For additional and more detailed news see Section 2, starting on p. 300.



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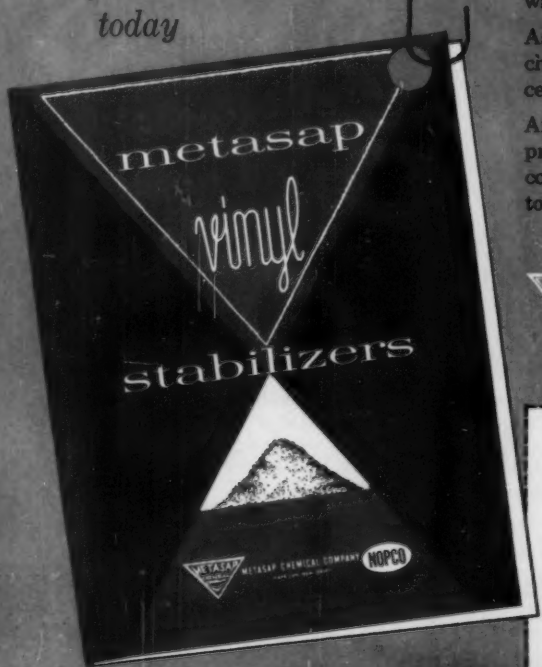
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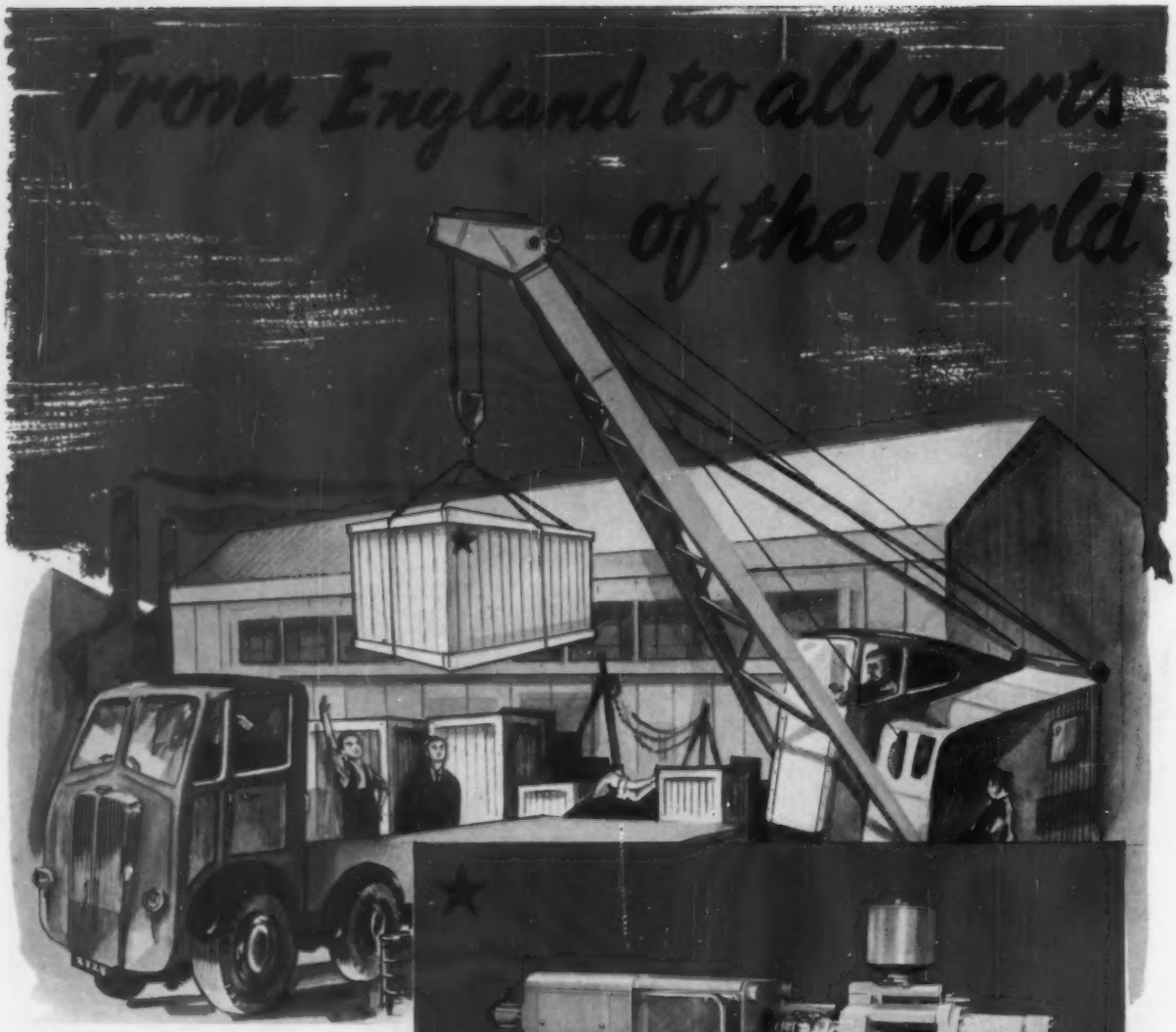
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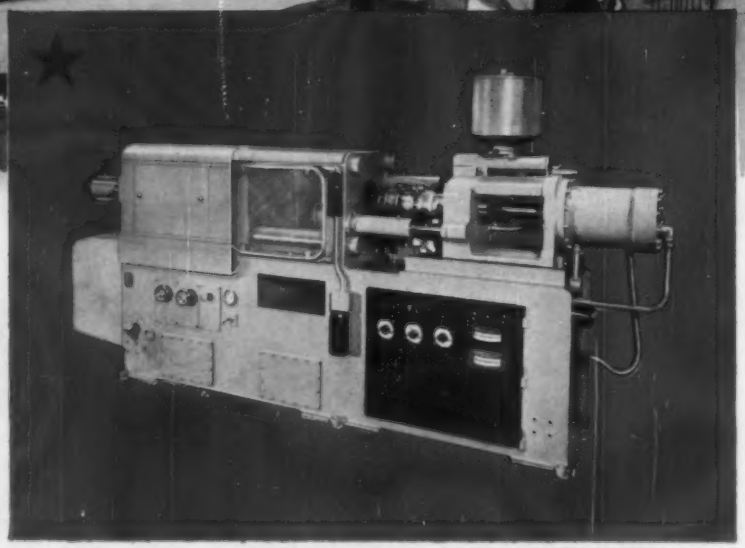
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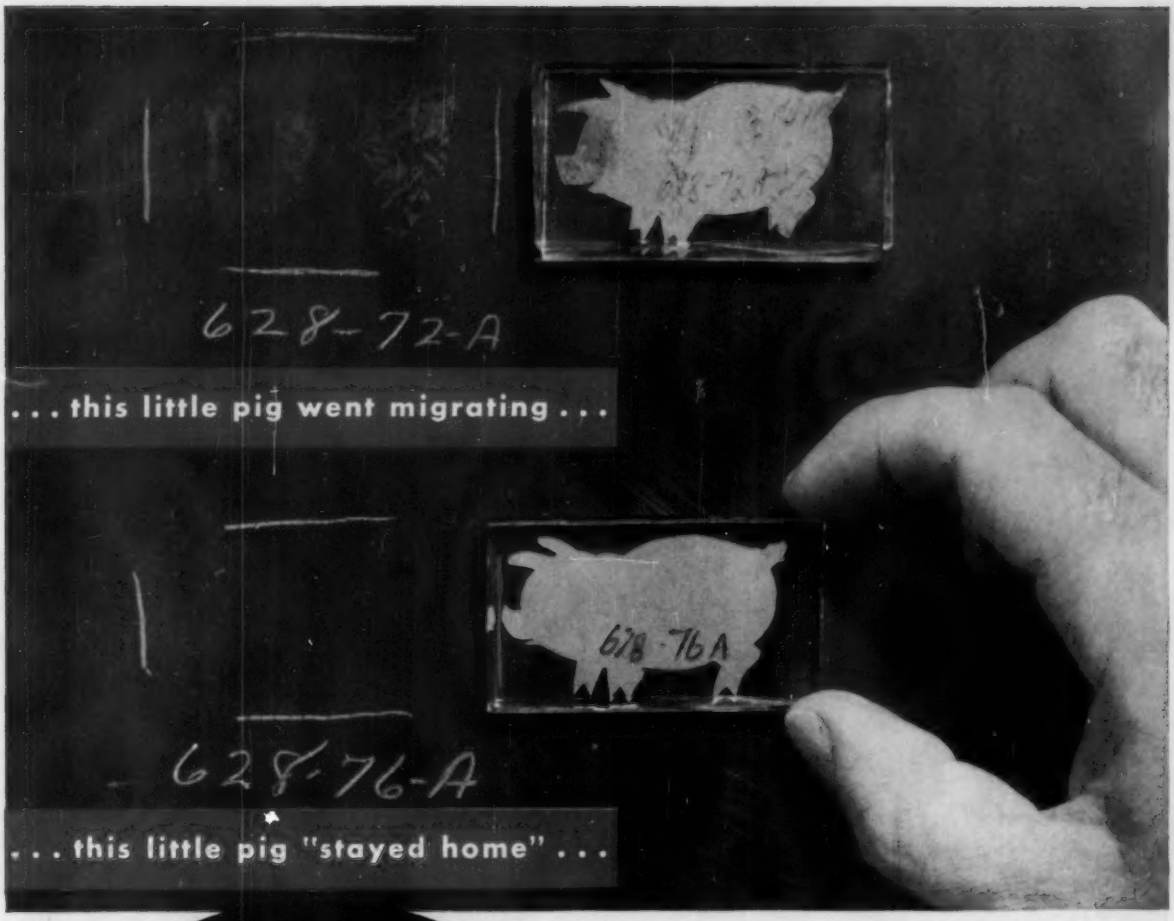
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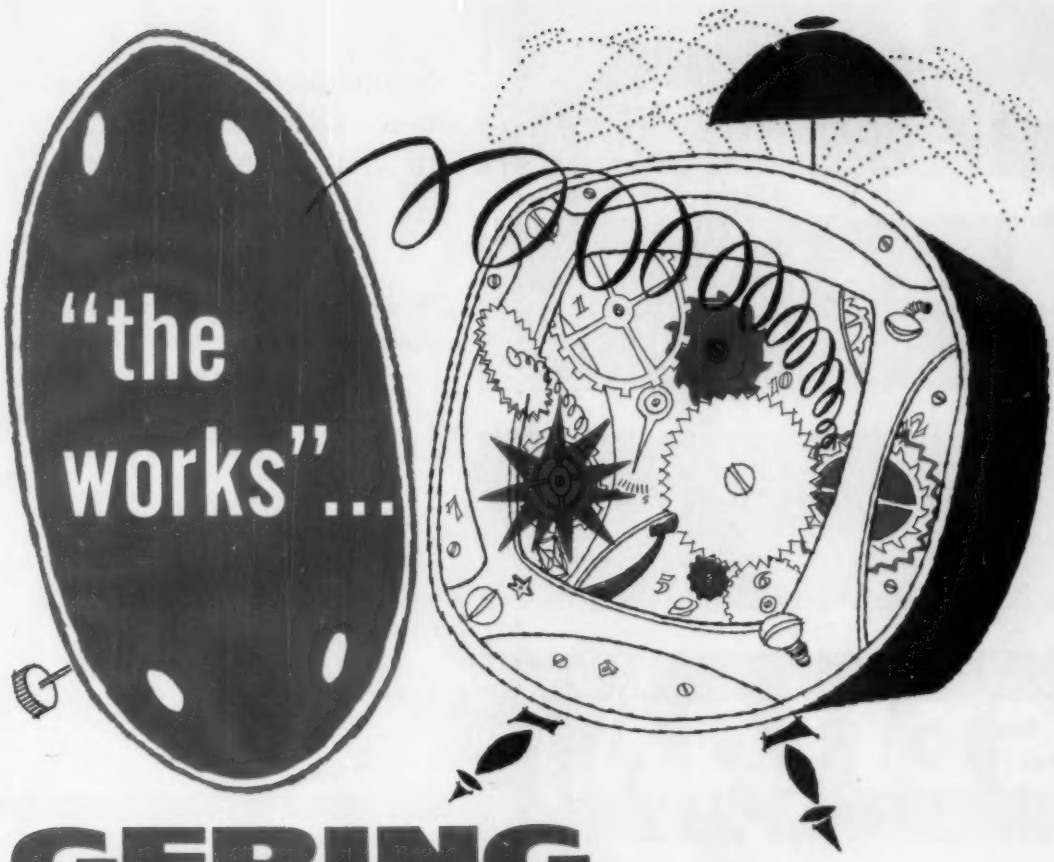
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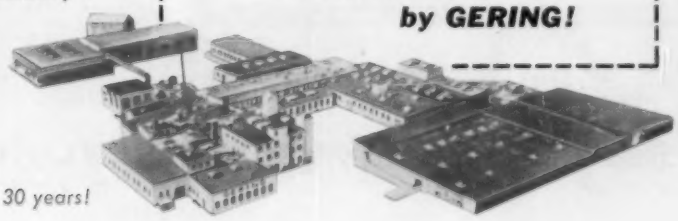
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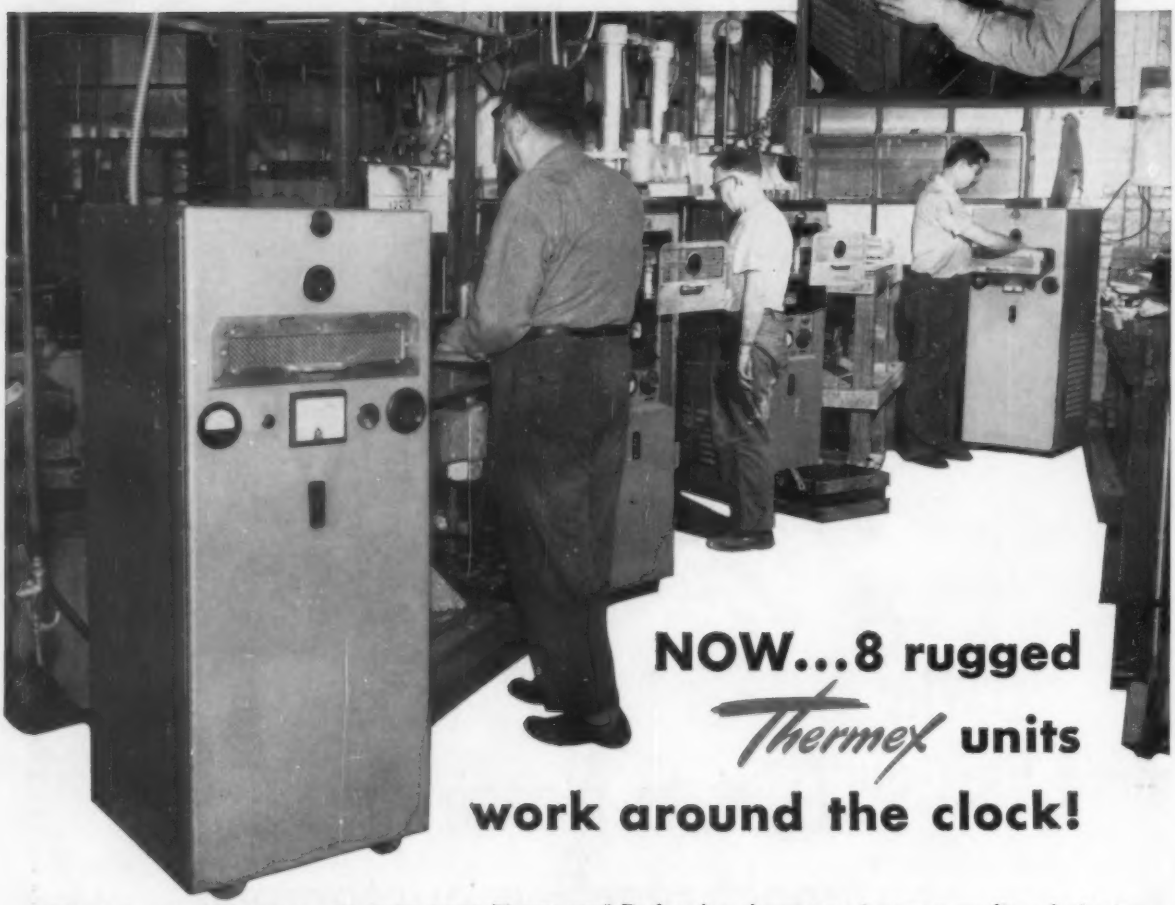
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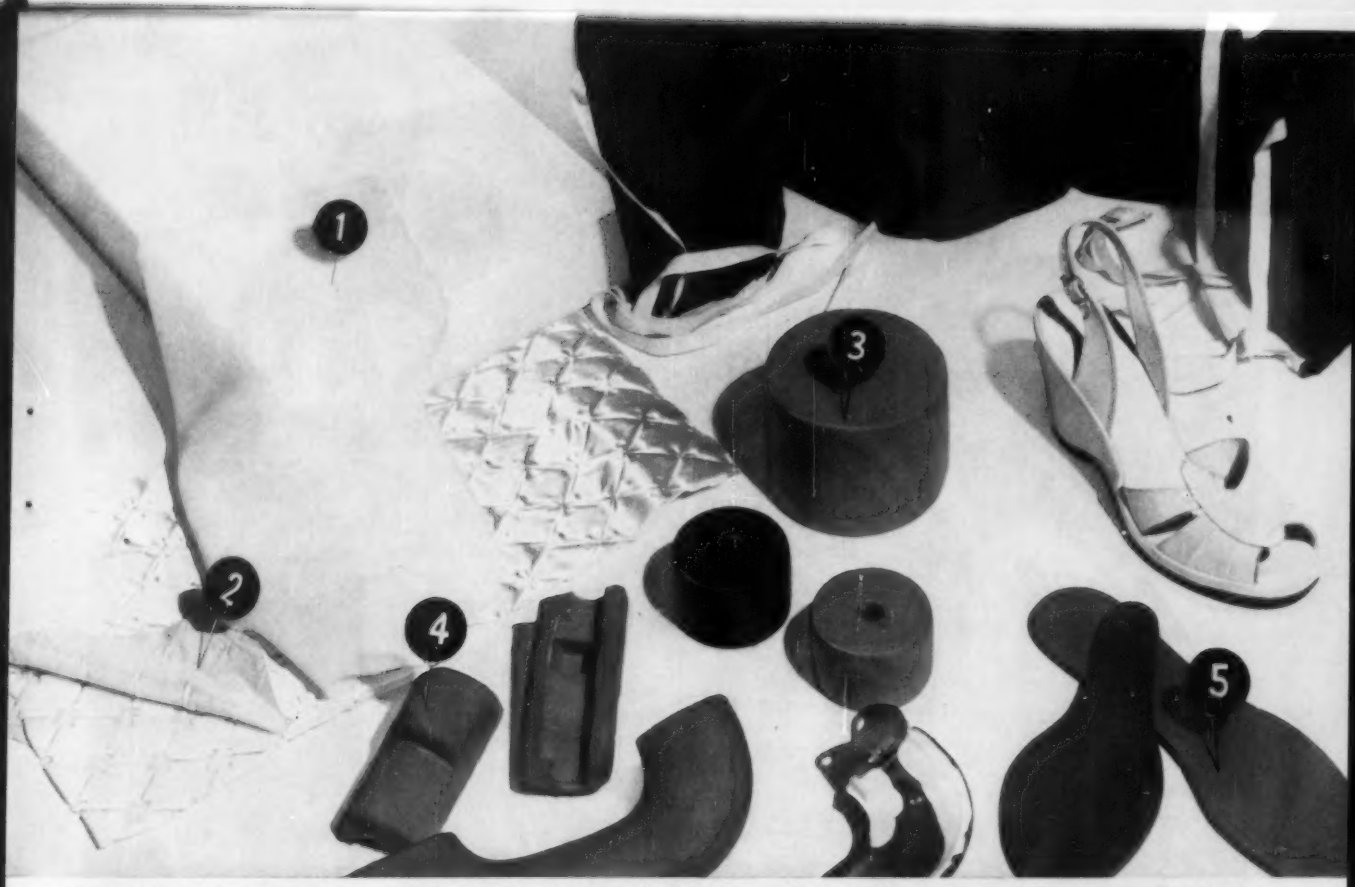
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1. Block of vinyl foam by Crest Chemical Industries Corp., Brooklyn, N.Y. **2.** Thin sheet sliced from block is heat-sealable; can be sandwiched between fabrics to provide quilted effect. **3.** Fish-net floats, by Linen Thread Co., Paterson, N.J. **4.** Solenoid valve shield, by U.S. Rubber Co., Ft. Wayne, Ind. **5.** Semi-rigid foam soles, by Foam King, Inc., Bronx, N.Y.

Why Du Pont BL-353 blowing agent gives high-quality PVC (polyvinyl chloride) foams for many applications

This general-purpose blowing agent:

- *Produces* uniform cells in thin or thick sections
- *Liberates* nitrogen at a uniform rate
- *Offers* excellent expansion efficiency
- *Eliminates* need for specialized equipment
- *Permits* a broad range of foam density
- *Provides* wide latitude in formulating plastisols—viscosities can range from 200 cp to over 100,000 cp
- *Is suitable* for producing either open-cell or closed-cell expanded PVC

Now available in quantity to meet rising demand

DU PONT BL-353

An Explosives Department Product

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

FACTUAL BULLETINS, YOURS FOR THE ASKING. These two bulletins on BL-353 give you more facts on this popular, multi-purpose blowing agent—may show you the way to a vinyl-foam product with high sales appeal.



E. I. du Pont de Nemours & Co. (Inc.)
Chemical Sales, Explosives Department—Room 2420-N
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Please send me:

☐ Free booklets ☐ Sample to test

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YES YOU CAN GET NRM

20:1 L_e/D RATIO

Thermoplastic EXTRUDERS



NRM 4½" Model 55
Electrically Heated Extruder

ALL IN SIZES . . .

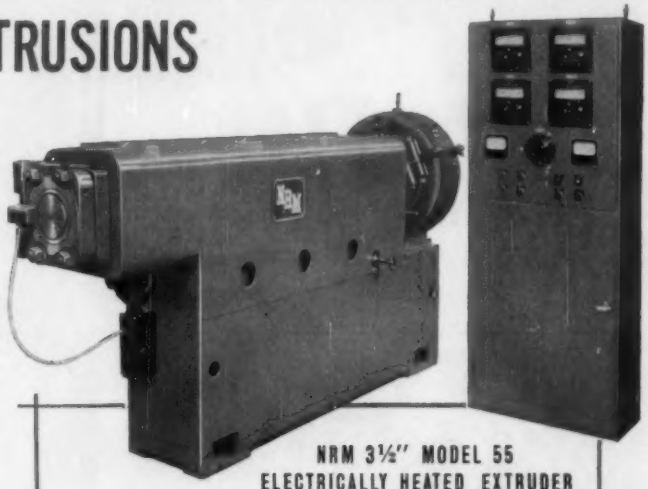
CITY_____STATE_____

TO GIVE YOU *More* EXTRUSION POUNDS PER HOUR . . . *finer* QUALITY EXTRUSIONS

20:1 Le/D cylinder ratios, the most significant advancement in plastics extruder development in many years, is now a standard feature of NRM Model 55 Extruders, and may be obtained in all cylinder sizes.

With effective cylinder and screw lengths twenty times their diameter (measured from feed opening to die), Model 55 Extruders provide, among other things, more thorough heating, combined with greater mechanical working of the plastic as it travels a longer path to the die. Whatever the extruder size may be, the physical characteristics developed in the plastic under these conditions result in extrusions of finer finish and shape-holding quality, produced with less waste and at 30 to 50% faster than with conventional machines of the same size.

To plastic manufacturers and processors, Model 55 Extruders offer the opportunity to excel in both the *quality* of their work, and in the ratio of *profit* realized from the work. Model 55's have all the traditional NRM advantages the plastics industry has long relied upon for most efficient extrusion — Balanced Heat Control . . . Quick-Opening Die Gates . . . Torpedo-Type Screws and others — PLUS the new 20:1 Cylinder development. Write for more details and information. See why NRM Model 55 Extruders will fit more compactly into your production system, and produce more top quality extrusion-pounds per hour than you've ever experienced with conventional machines.



NRM 3½" MODEL 55 ELECTRICALLY HEATED EXTRUDER

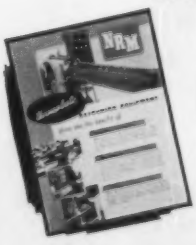
NOMINAL CAPACITY: 160-230 lbs./hr.
SCREW SPEED: Minimum range, 12-73 rpm
DRIVE: 25 hp—REDUCTION UNIT: Herringbone Gear, 24.5:1 Ratio
FLOOR SPACE: Extruder—112" long x 36" wide
Control Cabinet—19½" deep x 28" wide

NRM 3½" ELECTRICALLY HEATED DEVOLATILIZING EXTRUDER (24 : 1 Le/D RATIO)



Where devolatilization is required, NRM supplies Extruders with venting arrangement built integral with the cylinder. These machines not only remove moisture without use of unwieldy pre-drying attachments, but eliminate porosity in extrusions by removing other volatile constituents whose boiling point is reached inside the machine.

DATA ON MODEL 55 EXTRUDERS AND MATCHED ACCESSORIES IS CONTAINED IN OUR LATEST SPECIFICATION BOOKLET



WRITE FOR IT TODAY!

2455-1

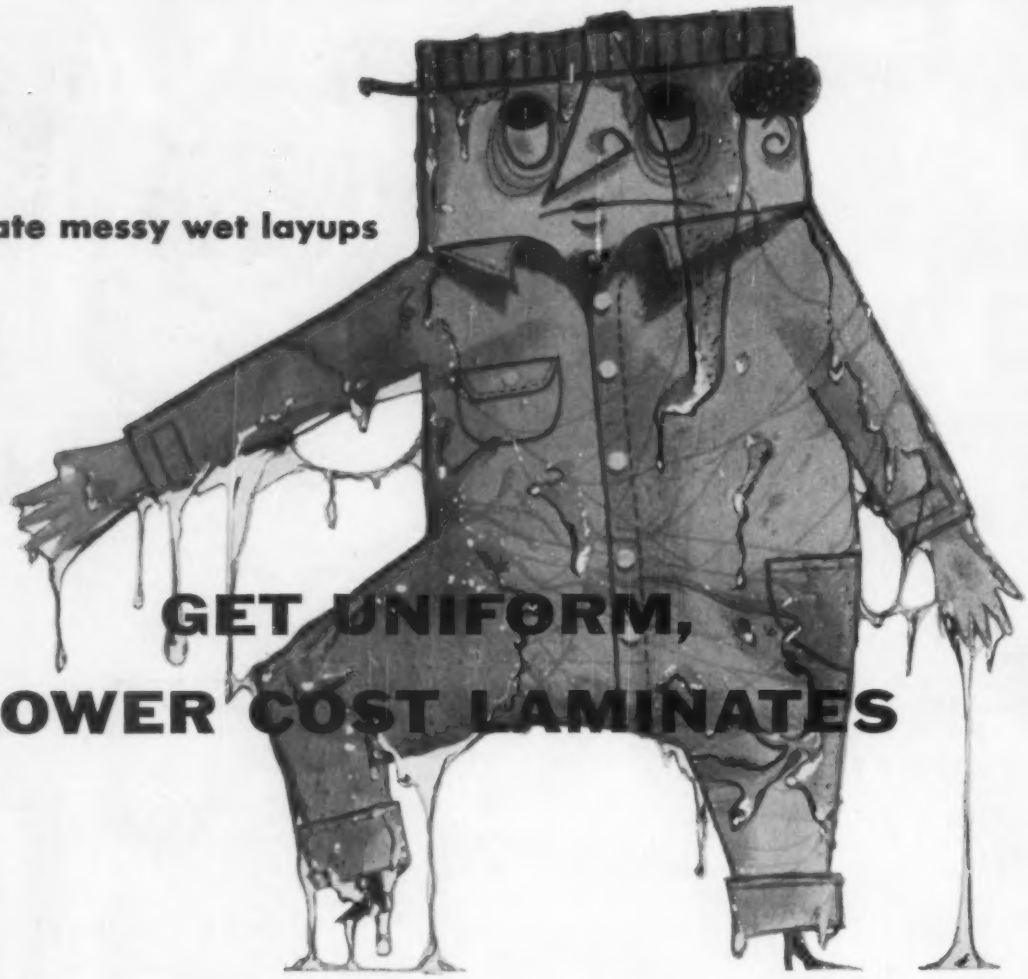
NRM

NATIONAL RUBBER MACHINERY CO.

General Offices and Engineering Laboratories:
47 West Exchange St., Akron 8, Ohio—Hemlock 4-1961
EASTERN PLANT: 384 Getty Ave., Clifton, N. J.
SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.
WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.
MIDWEST: National Rubber Machinery Co., 5875 North Lincoln Ave., Chicago 45, Ill.
CANADIAN: F. F. Barber Machinery, Ltd., Toronto, Ont.
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eliminate messy wet layups



GET UNIFORM, LOWER COST LAMINATES

Trevarno preimpregnated glass fabrics help you make better quality products, faster and more efficiently. Our exclusive "one company" operation performs weaving, finishing and impregnating under one roof, provides consistently uniform materials. It's this uniformity that assures proper drape, tack, flow, and resin and volatile contents layup after layup. Consequently, you can standardize your processing operations and cut costs.

A complete schedule of impregnations are offered in Phenolic, Epoxy and Silicone resin systems. Custom impregnations are available to meet your critical needs. Write today for product data and prices.

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STABELAN 110 — "Single-Package" liquid, non-plating stabilizer compounded of cadmium and barium organic salts with chelating agent. Efficient heat and light stabilizer. Assures perfect dispersion quickly in all forms of vinyl processing. Excellent air release.

STABELAN 115 — "Single-Package" liquid, non-plating stabilizer for fast, perfect dispersion and high degree of film clarity. Compounded of cadmium and barium organic salts with chelating agent. Odorless. Excellent heat and light stabilizer.

STABELAN 120 — "Single-Package" liquid stabilizer compounded of zinc and barium organic salts with chelating agent. Non-Discoloring by hydrogen sulfide. Mixes quickly without preblending. Efficient heat and light stabilizer by itself and particularly when used with STABELAN 110 or 115.

Manufactured by Stabelan Chemical Company.

Write for bulletin giving complete STABELAN data

Other STABELANS

STABELAN HR-50 — (Fluid Paste) For all plastisol formulations. Contains plasticizer in addition to cadmium and barium with synergized chelating agent.

STABELAN HR-PASTE — "Single-Package" stabilizer with cadmium and barium and synergized chelating agent.

STABELAN HR-LIQUID — Synergized chelating agent.

STABELAN HR-POWDER — Metal bearing components of HR-PASTE.

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THE MARK OF QUALITY

BARBER COLMAN

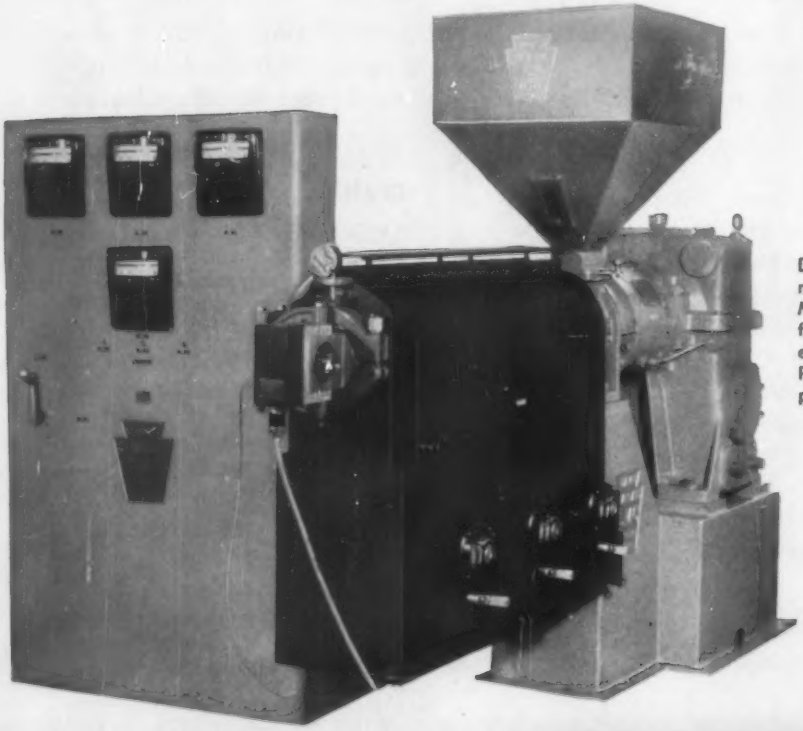
Wheelco Instruments

Heating...Cooling of Extruder Controlled by Capacitrol—Exactly!



MORE THAN 95% of the plastic fabricators in the Cleveland area have expressed their preference for Wheelco Instruments. Wherever plastic machines are used, Wheelco furnishes precise, dependable control at low cost.

Davis-Standard makes versatile Therma-Fin Extruders which handle a wide range of thermoplastic materials. Wheelco Model 401 Capacitrols are essential in the excellent temperature control system which distinguishes these machines. The control problem is complicated by the heat of friction generated when material is forced through the cylinder. Davis removes this heat by blowers which move cooling air across the externally finned surfaces of the cylinder sections. Automatic temperature control depends on the proportioning type controllers which balance heat input to the cylinders, with cooling needed to hold the machine at the precise operating temperature best for the material extruded. Davis has found Wheelco instruments extremely accurate and dependable. Whatever the temperature control problem, your Wheelco field engineer is ready to help you solve it. Find out why Wheelco leads in the plastics industry. Call him *today!*



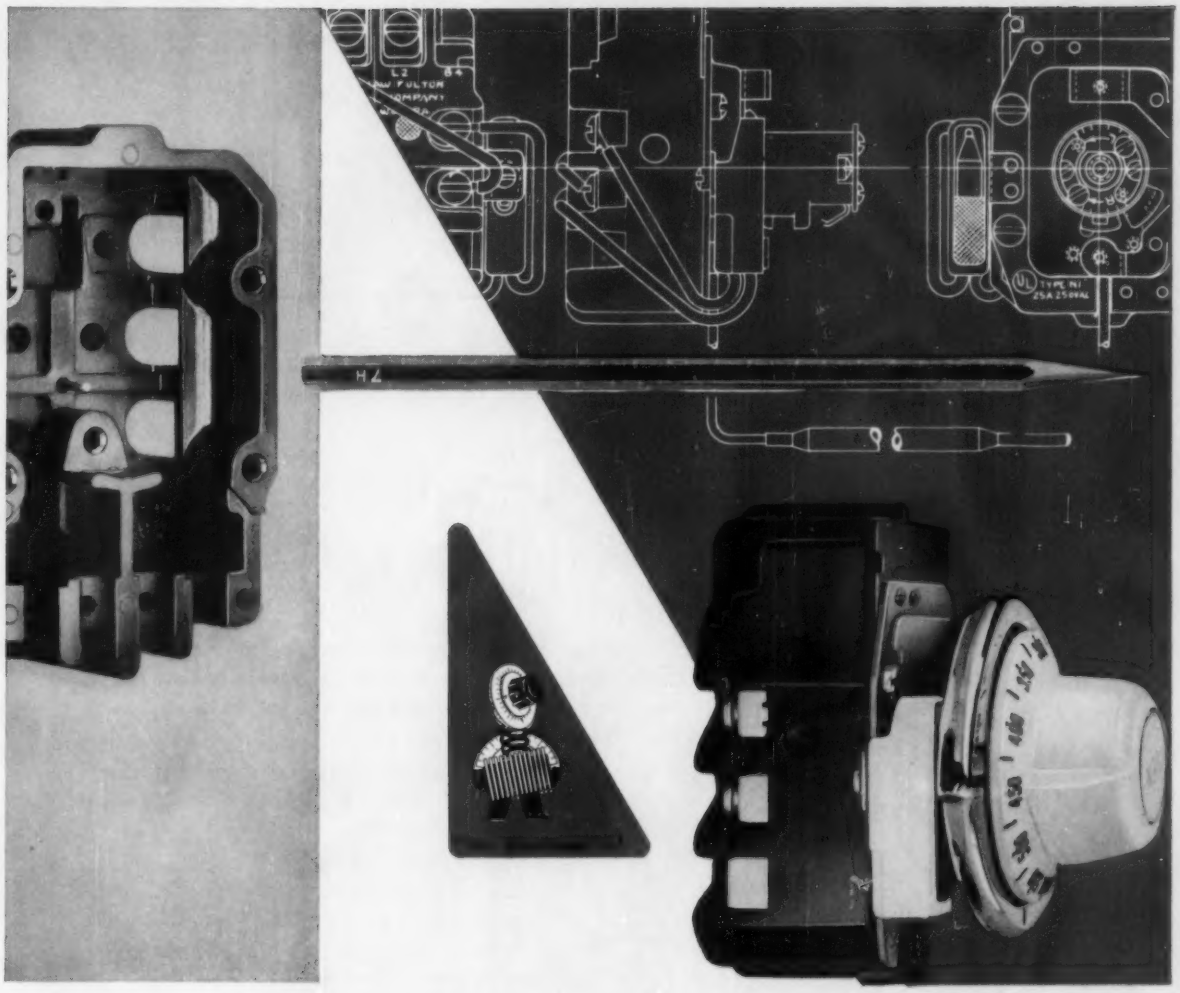
Davis-Standard 3¼ in. Therma-Fin Extruder uses four Model 401 Capacitrols—one for the head zone and one for each of the cylinder zones. Prewired Control Center simplifies maintenance.

WHEELCO INSTRUMENTS DIVISION

Barber-Colman Company

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BARBER-COLMAN of CANADA, Ltd., Dept. I, Toronto and Montreal, Canada



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Parts molded for a leading manufacturer of appliance controls like the Robertshaw-Fulton Controls Company must be easy to machine and finish . . . and have the dimensional stability so essential to perfect assembly and trouble-free service life. In addition, they must have good heat resistance and electrical properties.

That's why Robertshaw engineers, after consulting with their molder, Kurz-Kasch Inc., chose Durite GP-151 phenolic molding compound for the housing of Robertshaw's oven thermostat shown here.

The batch to batch uniformity of GP-151 is a primary reason for its popularity among leading molders. Its production is carefully controlled—from selected raw materials to the finished compound. Result: uniformity in every molded part.

You will find Durite GP-151 an ideal general purpose molding compound for parts that are large or small, intricate or simple, thin-walled or heavy-sectioned. Why not let us prove its value to *your* operation with a trial run? Contact The Borden Company, Chemical Division, Durite Products Dept., MP-106, 5000 Summerdale Avenue, Philadelphia 24, Pa.

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THE Borden COMPANY

CHEMICAL DIVISION

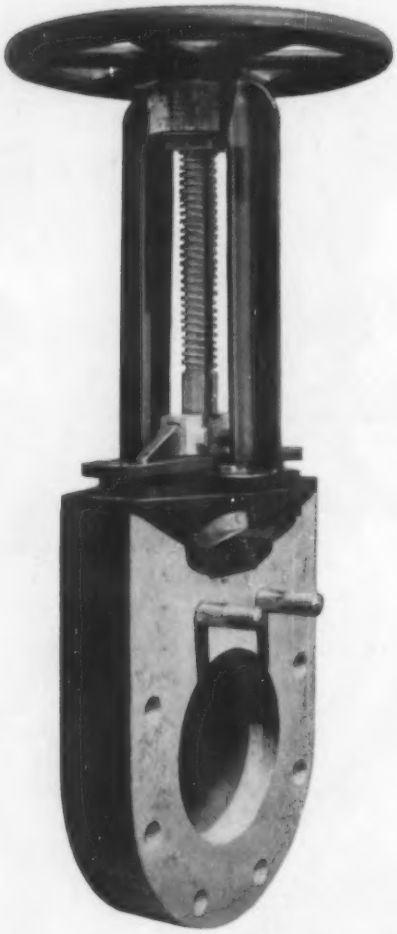
*"MR. CONTROLS" is a registered trademark of the Robertshaw-Fulton Controls Company.

Phenolic Molding Compounds • Abrasive and Frictional Bonding Resins • Molding and Specialty Resins • Lamp Basing Cements

FIBERGLAS *Reinforced* MOLDING COMPOUNDS

ALL THE PROPERTIES OF PLASTICS... PLUS!

- **Heat Resistance**
- **Strength**
- **Dimensional Stability**



The valve with vitality

"Vitality" means power to endure. And that's what this valve body has plenty of. It has vitality because it is made of Fiberglas*-reinforced molding compound.

Valves like these are saying "stop" and "go" to chemicals in the pulp and paper industry. They have to stand up to acids and alkalies, to great mechanical stresses, to wide temperature extremes.

These valves, in diameters from 4" to 12", offer the best in corrosion resistance at real savings . . . as much as 60% less than the cost of stainless steel. Also their much lighter weight brings additional savings in freight, installation and maintenance.

All this is possible because of the qualities of Fiberglas-reinforced plastic!

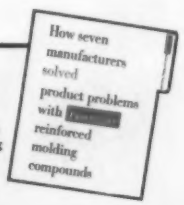
END USER and DESIGNER:
W. G. Rovang & Associates, Inc., Portland, Oregon

MOLDER:
Grant and Roth Plastics, Inc., Portland, Oregon

MOLDING COMPOUND:
Fiberglas-reinforced polyester by Thermaflow Chemical Corporation, Tunkhannock, Pa.

It's amazing the difference Fiberglas makes!

*T. M. Reg. Owens-Corning Fiberglas Corp.



Free case history folder: Outstanding examples of how other manufacturers have improved products, lowered costs with Fiberglas-reinforced molding compounds. If you have not already received this folder of case histories, plus a list of molding materials suppliers—send for your copy today.

write to OWENS-CORNING FIBERGLAS *Dept. 125J, Textile Products Division, 598 Madison Ave., New York 22, N. Y., for full list of suppliers.*



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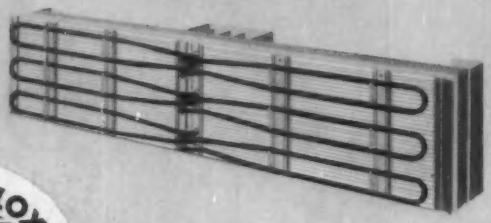
Ask for Bulletin L-1104-A



MODULAR RADIANT PANELS

A high-intensity, accelerating heat source. Four standard, modular panels completely factory assembled with built-in continuous bus, reflector, insulation, frame and mounting. Lets you tailor heat source exactly to process requirements.

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CHROMALOX

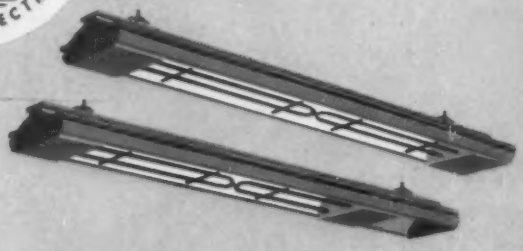
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RADIANT HEATERS

For assembly in banks. Two bolts to hold it; two wires to connect it. Six standard lengths, 14 standard wattages. Housing is rigid extruded aluminum with brightly polished parabolic non-oxidizing reflector.

Ask for Bulletin CS-604



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Ask for Bulletin CS-607

4 ways to put Far-infrared to work!

When you want reduced processing time, more uniform pre-heating, curing or pre-drying, or increased heating capacity on existing equipment, put Chromalox Far-infrared on the job! The long wavelength makes the difference.

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Contact your Chromalox representative for helpful information on Far-infrared for your application.

Edwin L. Wiegand Company

7503 Thomas Boulevard, Pittsburgh 8, Pa. B-703

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Investigate Du Pont "Monastral" Blues and Greens for the plastic products you make. If you have a plastics pigmenting problem, Du Pont pigments experts will gladly work with you to find the right answer. For complete information about Du Pont pigments and technical service, get in touch with your nearest Du Pont representative today, or write: E. I. du Pont de Nemours & Co. (Inc.), Pigments Dept., Wilmington 98, Delaware.

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If you're looking for a molder with graduate degrees from the school of hard knocks—and from top-rated schools of technology, too—give us a ring. We don't go in for magic, although sometimes the results we get make customers think we do.



BOONTON MOLDING CO.

BOONTON, NEW JERSEY

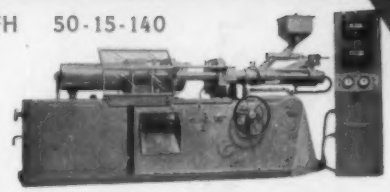
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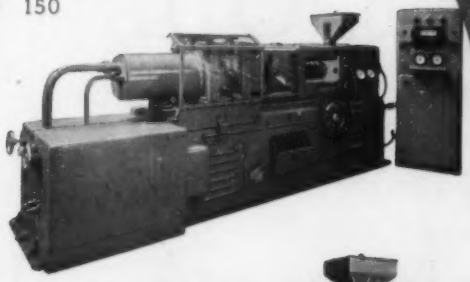
JAYBERT

PLASTICS MOLDING MACHINERY
FOR THERMOPLASTIC AND THERMOSETTING MATERIALS

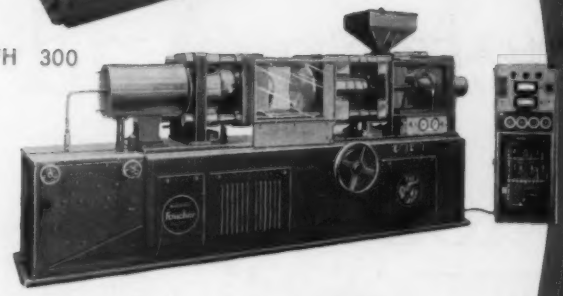
* FH 50-15-140



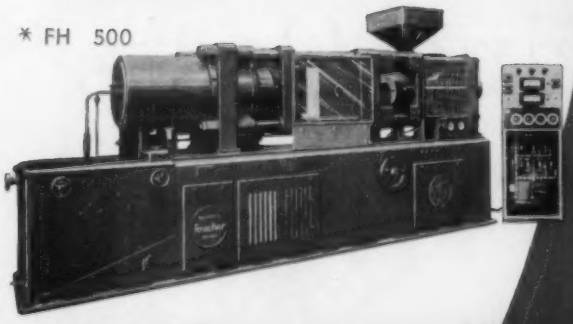
* FH 150



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Thanks to long experience and advanced techniques, these machines represent the utmost in power and automaticity. Their continual improvement assures ever-larger and more finely finished plastic products.

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Model	Capacity	
	Grammes	Ounces
FV 50	50 - 60	2
FV 100	100	4
FV 150	150	5

HORIZONTAL INJECTION PRESSES

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* FH 50-15-140	60 - 70	2½
* FH 150	150	5
* FH 300	300	10
* FH 500	500	17½
** FH 1500 polystyrene	1500	50
polythene	2500	90

** full-cycle automatic controls available for these models upon request.*
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* WRITE for CATALOGUE

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For years Mobil D.T.E. oils have set the standard of quality for all hydraulic and circulating oils. Recently they were dramatically improved—so much so that their margin of superiority is now greatly increased.

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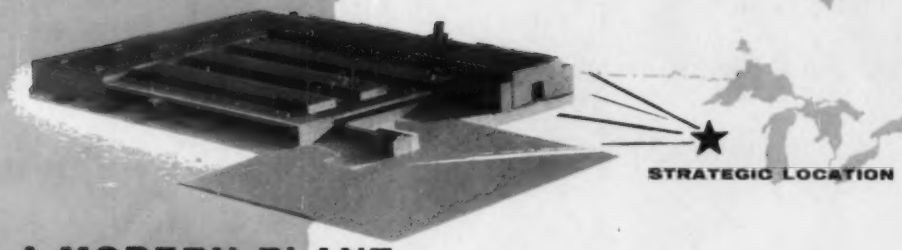
Let us show you concrete *proof* that new balanced Mobil D.T.E. oils can improve production and cut manufacturing costs. Ask your Mobil representative for the "balanced" story.



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FIRST STEP IN CUTTING COSTS

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION



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Our central location in the upper mid-west enables us to provide customer service to all major manufacturing centers at a minimum of distribution cost.



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Your inquiries are invited.

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PLASTIC RAINWEAR is a good example of the way vinyl products can be improved by the right Hercoflex plasticizer specifically chosen to provide the wide range of basic properties needed.



PLASTIC TOYS are another of the end products that give longer service when a Hercoflex plasticizer is used. No matter what the service requirements, there is a member of the Hercoflex family to supply them.

Rain or Shine

HERCOFLEX PLASTICIZERS IMPROVE VINYL PERFORMANCE

No matter what property—or combination of properties—you seek in a plasticizer, there is a Hercoflex that will meet your requirements with "tailor-made" precision.

The Hercoflex family has been developed specifically for those vinyl processors who realize that no single plasticizer can be versatile enough to meet all requirements. That's why so many processors are becoming better acquainted with the Hercoflex family, so that they can select the *one* plasticizer that will do their specific job best.

Whether you want the top performance of Hercoflex 600, the low-temperature flexibility and low volatility of Hercoflex 150, or plasticizers where the major emphasis is on economy, you'll find the answer here.

Would you like to know more? Write to Hercules, outlining your specific requirements, and we'll be glad to send you technical data on the Hercoflex plasticizer that best fits your specifications.

HERCOFLEX®
VINYL PLASTICIZERS

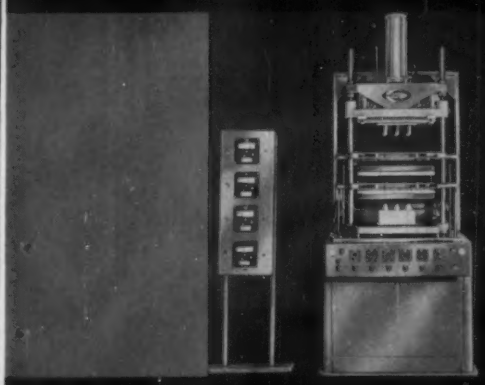
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SH56-1

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in a matter of seconds

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If you can picture a compact unit that combines straight vacuum, drape, and plug forming . . . that handles the entire job, from beginning to end . . . and that actually chops off (not merely nibbles at) labor, materials, and equipment costs . . . then you can understand why Vacuum Forming Corporation's new *Vac Trim* actually can *remake* your business.

Yes, the economies and the added range of operation that *Vac Trim* open to you can tremendously improve your competitive position, even to the point of taking you, quickly and profitably, into entirely new market areas.

Write, wire or telephone *now* for *all the facts, all the proof*, of what *Vac Trim* can contribute to your business—at once, in volume, and for a remarkably small investment.

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Name ..... *Title* .....
Company .....
Street .....
City ..... *Zone* ..... *State* .....
Principal business .....

look...

it's

TITANOX®

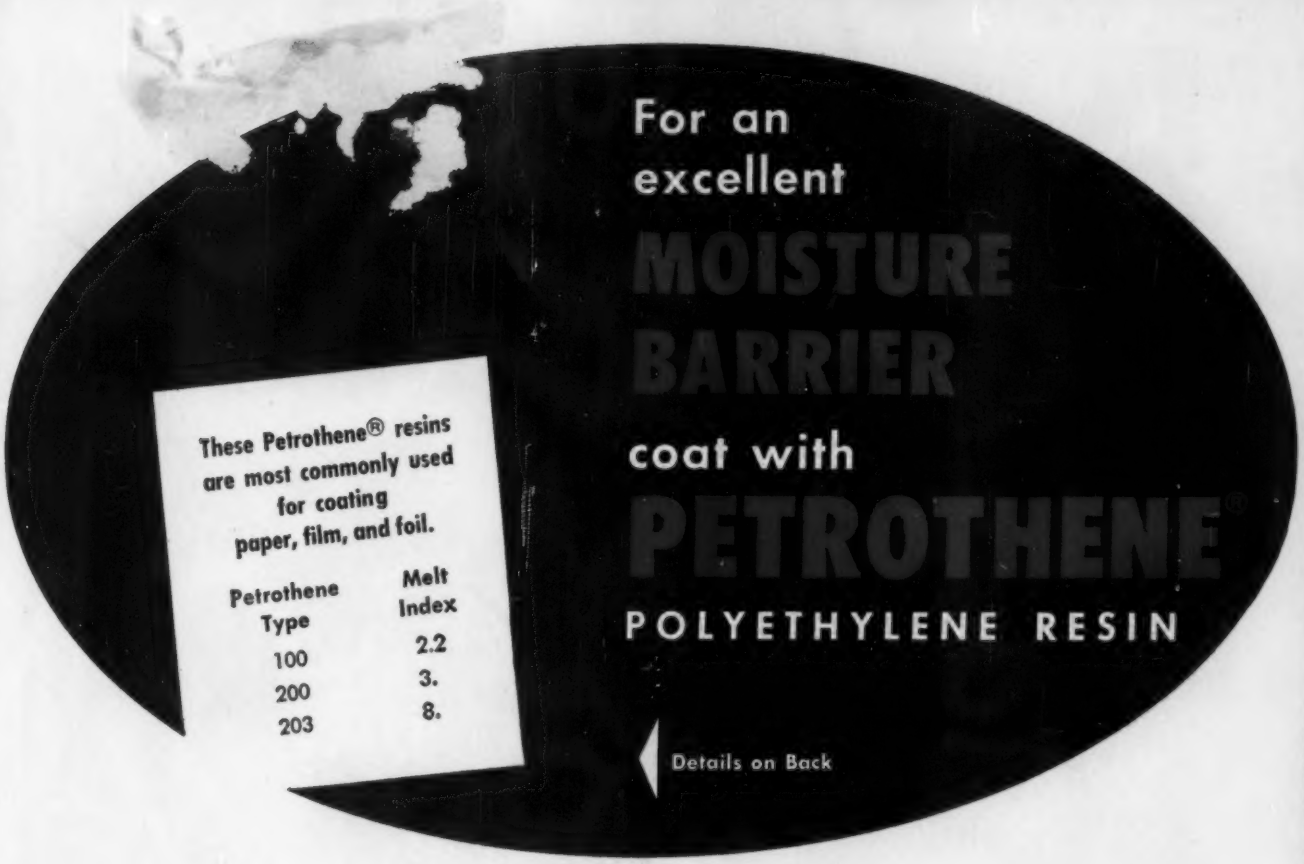
Rutile types of TITANOX white titanium dioxide pigments are universally acceptable for most types of plastics—whether extruded, molded, sheet, or film-coated. For white and light tinted stocks, TITANOX-RA provides maximum whiteness, brightness and opacity. For heavily loaded stocks where the high opacity of "pure" titanium dioxide is not needed, TITANOX-RCHT or TITANOX-C-50 may be used.

But whatever the use, no other whitening agent gives plastic products the color and sparkle—the eye-catching appearance—that TITANOX does. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta 5; Boston 6; Chicago 3; Cleveland 15; Houston 2; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 14, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1.



Titanium Pigment Corporation is a subsidiary of National Lead Company

3646-A



Polyethylene because of its low cost, high water vapor resistance, and excellent heat sealing properties, is becoming more and more popular for moisture barrier applications. It coats practically everything used for flexible packaging of industrial or consumer items. It adheres tightly to papers, fabrics, films and foils. It adds strength, too.

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chemicals
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textiles
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Division of National Distillers Products Corporation
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I would like more information on PETROTHENE Polyethylene.

My application is _____

Please ☐ send literature

☐ ask a technical representative to call.

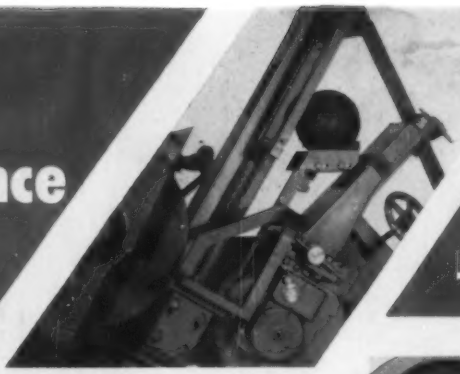
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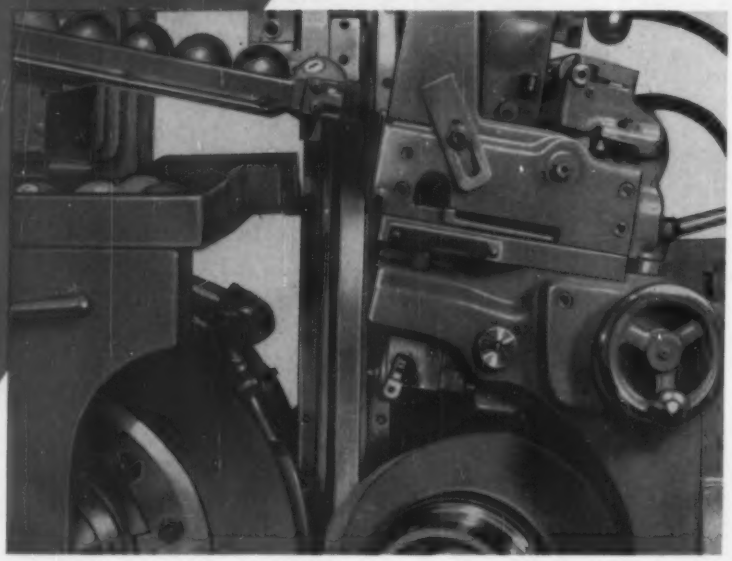
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How to Gain 30 Years' Experience *in Centerless Grinding Plastic Parts*



Above: **Bowling Balls** ground to exact size and a high finish on CINCINNATI FILMATIC No. 4 Centerless. Below: Twenty sizes of **Pool and Billiard Balls** ground on CINCINNATI FILMATIC No. 2 Centerless.





Pen and Pencil Parts ground at production rates up to 1200 per hour, on CINCINNATI FILMATIC No. 2 Centerless.

Are you stumped by a centerless grinding problem on plastic parts? Well, you need not throw up your hands in despair; you can count on the right answer from Cincinnati grinding specialists. These men have the most extensive centerless experience and background available anywhere . . . over *30 years.* ¶ CINCINNATI FILMATIC Centerless Grinders, many with complete Cincinnati tooling, are grinding plastic parts like those illustrated here, at a negligible cost. In most cases, details of the operation were worked out and pretested in our Experimental Grinding Department. Let us put our long experience in building equipment for centerless grinding operations to work for you. Just give us a phone call, or write a letter and include details of your requirements.

CINCINNATI GRINDERS INCORPORATED

CINCINNATI 9, OHIO



CINCINNATI FILMATIC No. 2 Centerless Grinder. Catalog No. G-644-1.

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Plastic Tubes and rods ground at a rate of 100" per min. on CINCINNATI FILMATIC No. 2...

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U.S. Royalite *the sheet fabricating material that turns designers' dreams into practical realities*

Is the case, cabinet, cover or other part of your product now made of a material which leaves something to be desired in . . .

Economy? Royalite® assures exact, inexpensive prototypes . . . lower tooling, finishing and assembly cost . . . fewer operations.

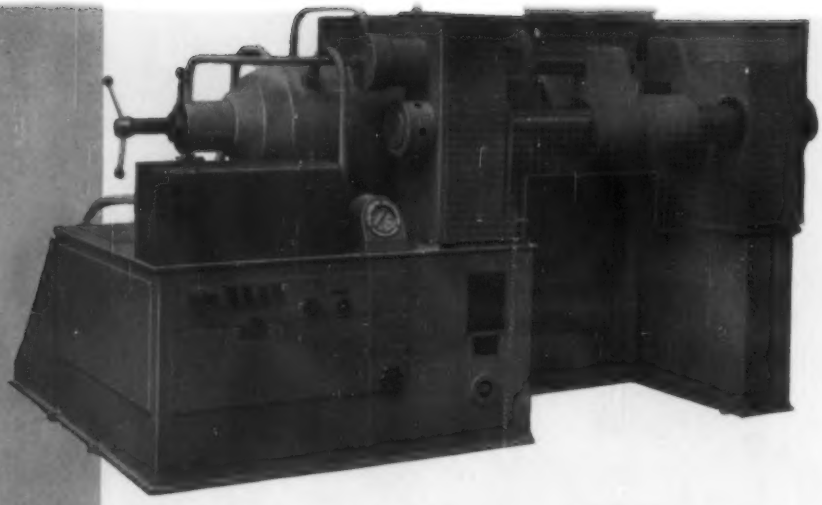
Beauty? Royalite molds readily to shape, detail and contour . . . retaining its eye-catching, sales-appealing color and texture.

Durability? Patented compounding of thermoplastic fortified with rubber gives never-before wearability. It's super-tough to resist impact . . . yet weighs less than any metal. Custom formulized to meet specific needs such as oil and chemical resistance, moisture-resistance, and performance at extremes in temperature.

There is a Royalite sales engineer in your area. If you would like to have this specialist call on you, please write United States Rubber Company, Royalite Division, 2638 North Pulaski Road, Chicago 39.

United States Rubber
2638 N. Pulaski Road, Chicago 39, Illinois

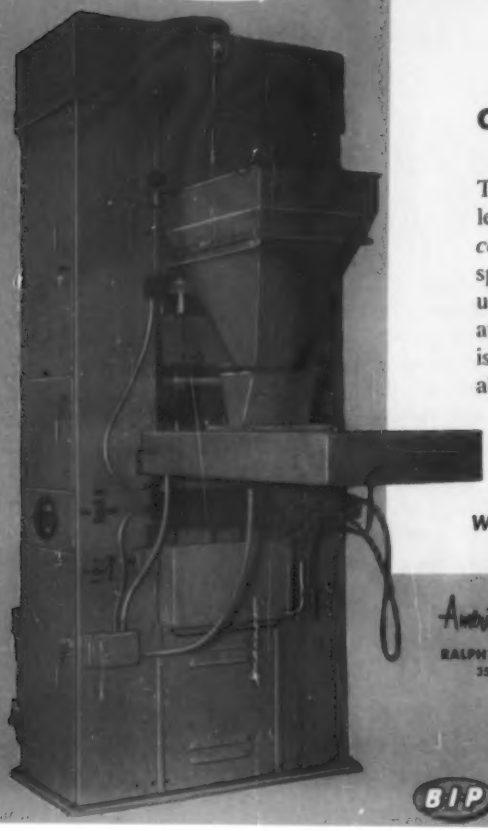
155 TON HORIZONTAL HYDRAULIC PREFORMER



Introducing

Unprecedented demand for the famous BIPEL 13, 36 and 78 ton Preformers has resulted in this new 155 ton model . . . capable of *producing preforms up to 6 lbs. each . . . and handling a ton of material per hour!* In operation, this unit features the same outstanding simplicity, cleanliness and precision as the smaller units . . . with independent controls for all phases of the cycle conveniently located for instant adjustment. You are assured of ✓ Equal Preform Density and Weight ✓ No Powder Loss ✓ No Jamming of Punches in the Die ✓ Easy Cleaning and Tool Changing ✓ No Damage due to Double Loading.

2 BIPEL units for high production



FULLY AUTOMATIC
COMPRESSION MOLDING PRESS

The compact new loading unit, shown on a standard BIPEL press left, is now available on any unit up to 170 tons capacity . . . for *completely automatic operation!* This table requires no more floor space than an operator with a semi-automatic press . . . and the unit may be converted back to semi-automatic molding, if desired, at the flick of a switch. As with all BIPEL equipment, this unit is remarkably clean and quiet, with an extremely fast but adjustable operating speed.

Write for complete illustrated data on both of these BIPEL units

American Inquiries to:
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...this is BIPEL

B.I.P. ENGINEERING, LTD.
Sutton Coldfield England



Outdoors two years—and PARAPLEX P-444 looks as good as ever

Two years ago, a test panel made of PARAPLEX P-444 polyester resin and glass fiber and a similar test panel based on a conventional polyester resin were placed on the roof of an isolated building. Today, after two years of continuous. exposure, the panel based on PARAPLEX P-444 is still highly transparent and is not discolored. Fiber evidence, too, is as slight as in the original sample. The panel based on the conventional resin, on the other hand, has lost much of its transparency, and fibers and discoloration are quite evident.

PARAPLEX P-444 polyester-acrylic resin offers to manufacturers of corrugated panels, flat sheets, awnings and decorative sidings these advantages:

- excellent wetting of and adhesion to glass fibers
- refractive index of cured resin similar to that of glass
- unusual resistance of cured resin to erosion and discoloration
- controllable transparency

For more details on PARAPLEX P-444 and other Rohm & Haas polyester resins, write to Department WEW-1-6.

PARAPLEX is a trade-mark, Reg. U.S. Pat. Off. and in principal foreign countries.

Chemicals for Industry

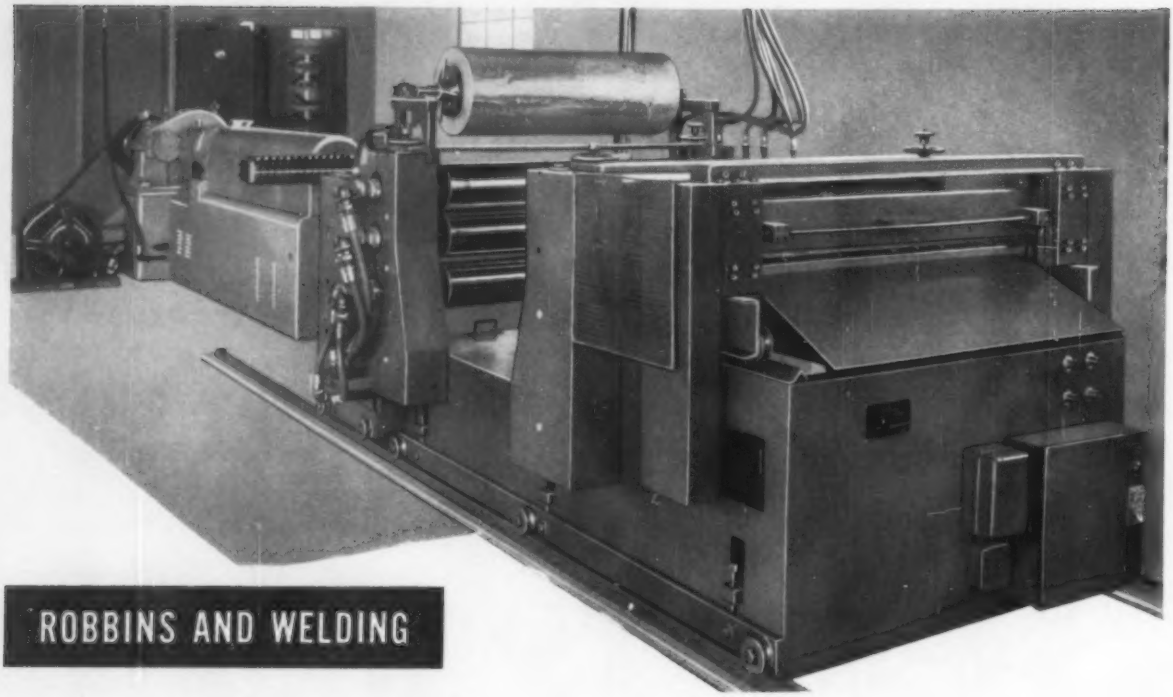
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Eastman NP-10 gives you



ROBBINS AND WELDING

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engineering responsibility

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engineering... Rates up to 600 lbs. per hour
One control cabinet for die and extruder

Plus these sheet haul-off features:

- Top and bottom roll adjustable • Mechanical or air
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responsibility... Both Robbins and Welding Engineers have laboratory and technical service personnel.

The installation and start-up of equipment we sell MUST BE supervised by our technical service people.

Robbins
never say die... say Robbins die

We deliver "the package" and "help you open it."

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Midwest Representatives: Welding Engineers

New

Polymeric Plasticizer

speeds

vinyl production



Eastman

CHEMICAL PRODUCTS, INC.

KINGSPORT, TENNESSEE

subsidiary of Eastman Kodak Company

Eastman NP-10 gives you

- Faster compounding
- Excellent permanence
- Lowest color

In selecting a polymeric plasticizer, vinyl compounders need compromise no longer between desired permanence characteristics and the rate at which such plasticizers can be compounded. Heretofore, permanence characteristics of available polymeric plasticizers have been a function of their molecular weight—with the high molecular weight compounds providing the best in permanence properties. On the other hand, as molecular weight increases, activity decreases, and hence production rates fall.

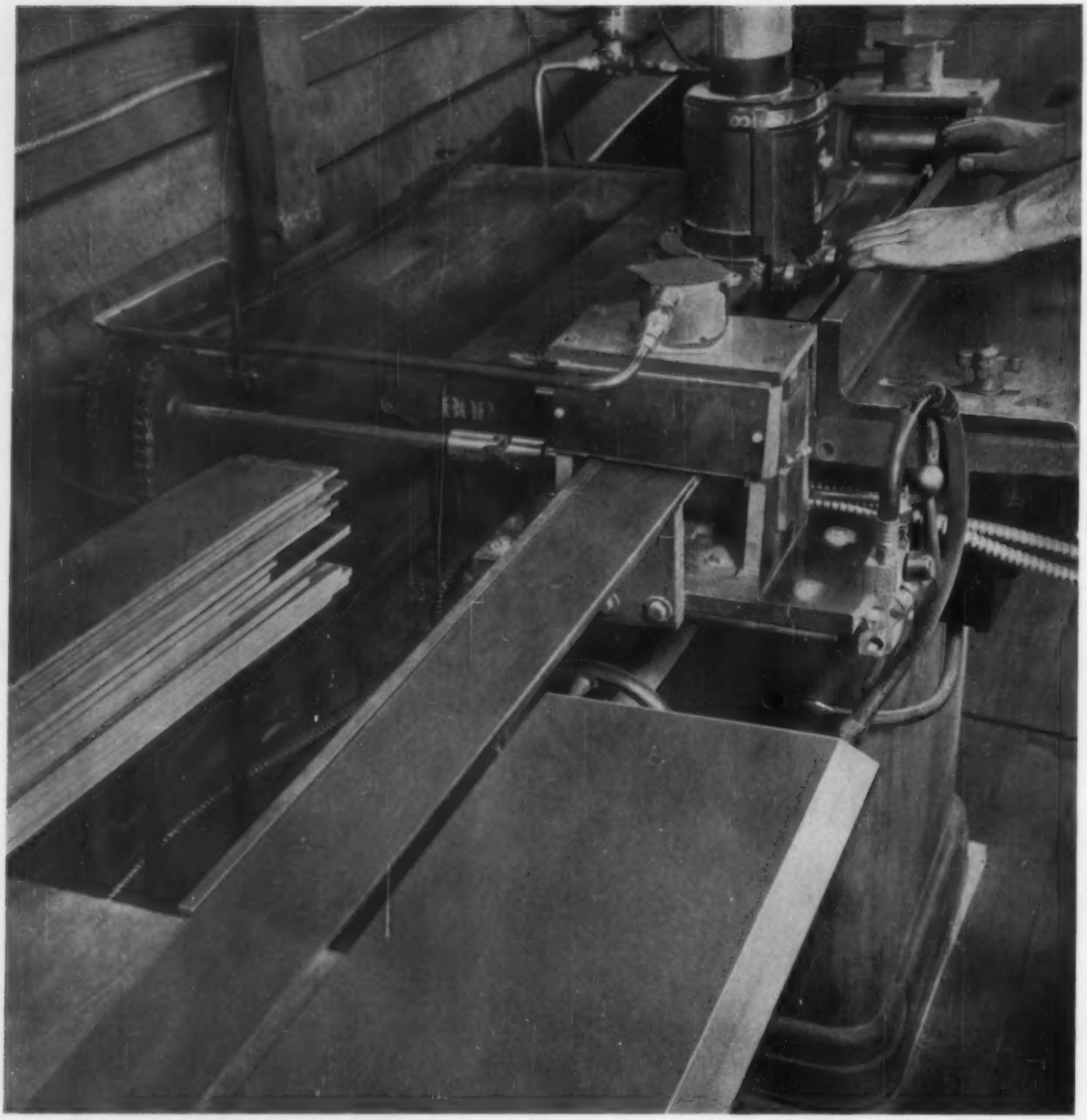
It is here that Eastman's new Polymeric Plasticizer NP-10 makes its greatest contribution. It exhibits the superior permanence properties of the higher molecular weight materials, yet is itself a compound of relatively low molecular weight. As a result, vinyl compounders can use NP-10, without modifiers, to achieve superior permanence while maintaining efficient production schedules. There's another dividend, too—Eastman Polymeric Plasticizer NP-10 has an APHA color rating of less than 100, a "first" in the field of polymeric plasticizers.

Key to this Eastman development is the use of neopentyl glycol as a base. Unusually stable due to its uniform chemical structure, neopentyl glycol produces polymeric plasticizers which possess outstanding permanence at only moderate molecular weights.

Eastman Polymeric Plasticizer NP-10 is a clear viscous liquid. It is highly resistant to hydrolysis, and thus can be expected to remain unaffected by moisture under the most severe outdoor weathering conditions. It produces vinyl films of excellent low-temperature flexibility. Its loss from vinyl films to hydrocarbons, soapy water and activated charcoal is extremely low, thus ensuring complete plasticization throughout the life of the plastic material. As a vinyl plasticizer, Eastman Polymeric Plasticizer NP-10 shows little tendency to migrate to materials with which such vinyls might come into contact. In addition, tests have shown it to produce excellent organisols and plastisols.

For superior permanence coupled with easier and faster processing, investigate Eastman Polymeric Plasticizer NP-10. Write for a copy of our brochure describing this unique new plasticizer. EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.



A SHARP SLANT ON PRODUCTION – Doctor blades, like so many of the precision parts used for the manufacturing of paper, must be carefully engineered to extremely close tolerances. Lodding Engineering Corporation of Worcester, Mass. are able to meet the most rigid specifications by fabricating doctor blades from a composition material called Panelyte. Manufactured by the St. Regis Paper Company, Panelyte can be accurately machined to a tolerance of .001 inch. A laminated plastic material, it is often made from a base of Mt. Vernon duck.

This is another example of how fabrics made by Mount Vernon Mills, Inc., and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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Here at Adamson we've been doing something that we believe is rather unique in the industry. Every now and then a manufacturer of rubber or plastics has expressed a desire to discuss certain problems pertaining to calendering or calendering equipment, and we have invited him and his associates to our conference room for a roundtable session with our staff. No one dreamed the idea up—it just grew. Some of the largest manufacturers in the industry have been our guests and have described the meetings as helpful and enlightening.

Certainly, since we build calenders and related equipment, these clinics have been of great value to us. And because we believe that a free exchange of opinions and ideas is the surest way to promote progress and improvement in any industry, we extend to you and your company a cordial invitation to our conference room. Perhaps, like the famous riddle of which came first, the chicken or the egg, many questions will have to be left unanswered, yet the benefits to be derived from a free discussion of our common problems cannot fail to be mutually helpful.

Why not 'phone or write us for a conference date? The obligation will be all ours.



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WANT ECONOMICAL COLD-HOBBING?

Choose DURAMOLD A, B or C

If you are engaged in cold-hobbing plastic dies, you'll be interested in the economies made possible by Bethlehem's Duramold tool steels. The Duramold grades—A, B and C—save time and money because they do the job right, the first time, as all three grades are free from injurious surface and internal defects.

DURAMOLD A. An air-hardening steel. Easy to hob. Annealed to a hardness of 109 max Brinell, with high core-strength (RC-30) after heat-treatment. After carburizing, the smooth surface can be polished to a rich lustre.

DURAMOLD B. An oil-hardening steel. Hobs more readily than Duramold A. It is annealed to 100 max Brinell. Has addition of boron, which increases the core-strength, without detriment to hobbing. Steel takes high lustre after carburizing.

DURAMOLD C. A water-hardening steel, low in carbon. Easiest to hob, because it is annealed to 90 max Brinell. After carburizing and heat-treating, develops a case hardness of about RC-62.

TYPICAL ANALYSES

GRADE	C	M	Si	Cr	Mo
Duramold A	0.07	0.40	0.25	4.50	0.45
Duramold B	0.07	0.30	0.15	1.00	(Boron added)
Duramold C	0.06	0.15	0.10	—	—

Your Bethlehem tool steel distributor will be pleased to give you further information about the Duramold grades and the economies they make possible.

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BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

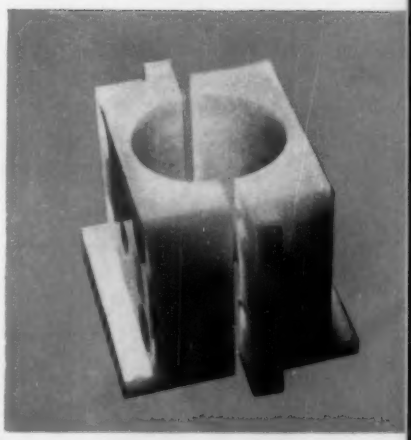
BETHLEHEM STEEL

BETHLEHEM TOOL STEELS

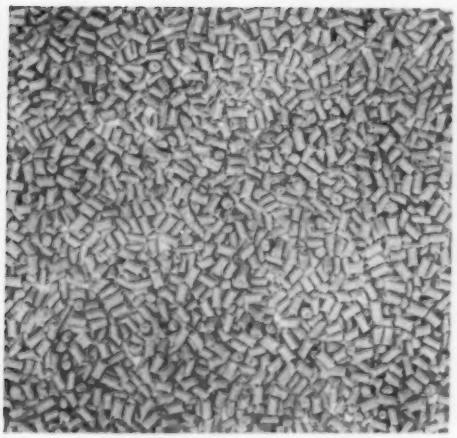
BASF Polyamide Plastics

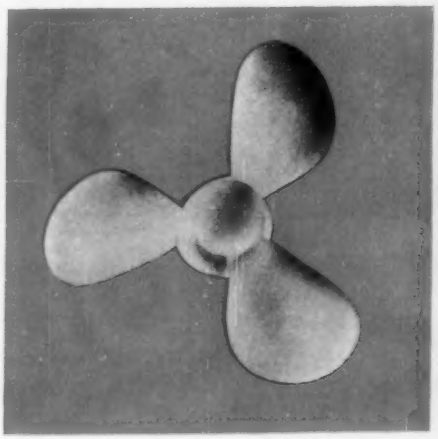
®ULTRAMID is the commercial name for the BASF range of polyamide plastics. ULTRAMID is a structural material for applications of an engineering nature such as precision instruments and textile machinery. The outstanding features of the material are its low specific gravity and high mechanical strength and toughness. In view of its high abrasion resistance, low coefficient of friction, good sound absorption, and excellent resistance to wear, even in the absence of lubricants, ULTRAMID is eminently suitable for use in friction bearings, gears and other machine parts. The various polyamide grades have outstanding resistance to oil and solvents.

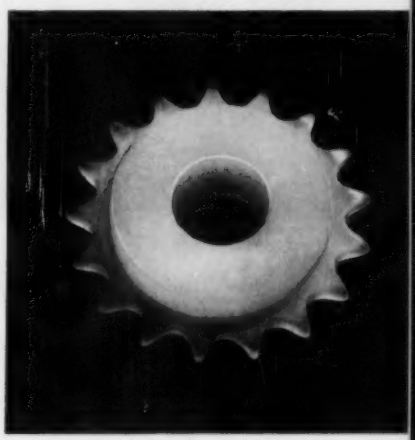
ULTRAMID is processed by injection molding, centrifugal casting, extrusion and blow molding to finished parts, sheets, films, rods, pipes, bottles and other containers.



U/469







Several ULTRAMID grades with different properties are available

ULTRAMID A	especially hard
ULTRAMID BM	hard
ULTRAMID B	soft
ULTRAMID S	hard, with very low water absorption



These grades are also supplied in qualities with exceptionally high melt viscosity.

Our Application Department will be glad to assist you with any special information you may require. Literature on ULTRAMID will be supplied on request.

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light-to-heavy gauges..cut and slit-to-size

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An attractive counter display container for Yardley English Lavender talc powder and toilet water made of JODA crystal clear ACETATE by **PLAXALL,** Long Island City, N. Y.

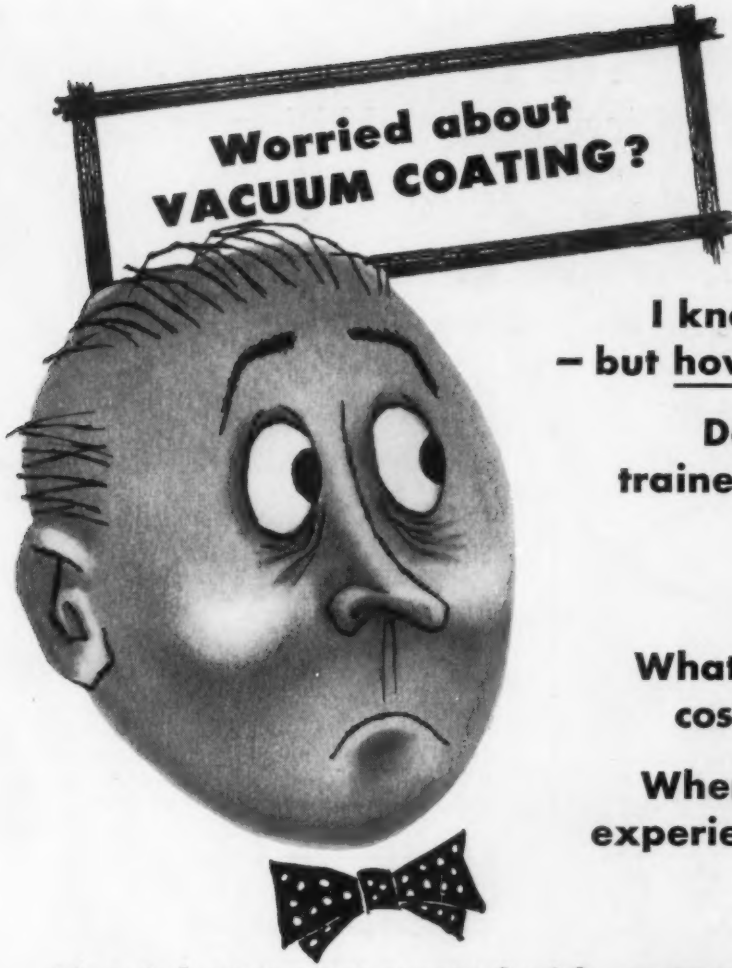
JODA EXTRUDED CELLULOSE ACETATE SHEETS, ROLLS AND FILM declared to be best quality on the market . . . the result of a survey conducted by one of the largest chemical manufacturers in America.

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I know it's low cost – but how do I get started?

Do I need trained operators?

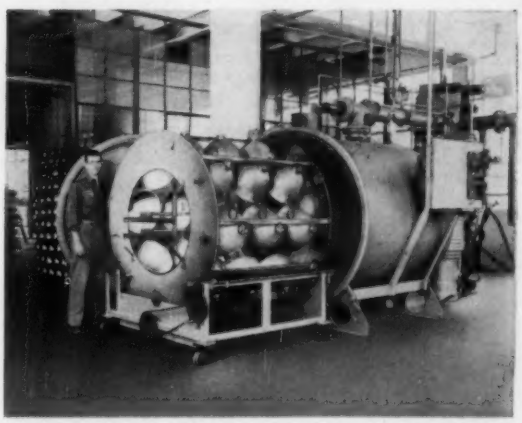
What's the story on lacquers?

What will my costs be?

Where do I get experienced advice?

Here's how to get started with low-cost vacuum coating . . .

It is really quite simple. National Research technicians have a great store of vacuum coating experience available for your use. They are experience-equipped to design a *complete vacuum coating system* for you. Give you an idea of your costs ahead of time. Supply you with a vacuum-coated sample of your product. Make the installation. Advise on lacquers. Train operators. Stand by to help you quickly get into profitable production. Here's the easy, sure way to use the latest, low-cost method of coating metals and plastics with beautiful metallic coatings. Send coupon.



Reflector finishing costs dropped 75% when this National Research vacuum coater replaced electroplating.

NRC high vacuum products include: dehydrators, freeze driers, gas analyzers, impregnators, gauges, metallizers, pumps, valves, vacuum furnaces.

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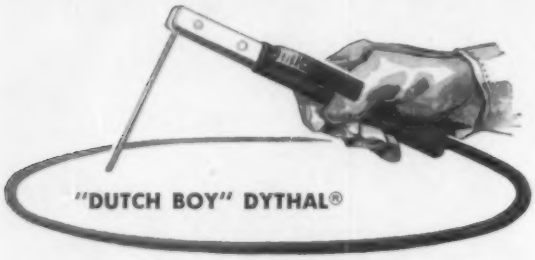
TOPS

in vinyl-insulation stabilizing

...the "Dutch Boy"...

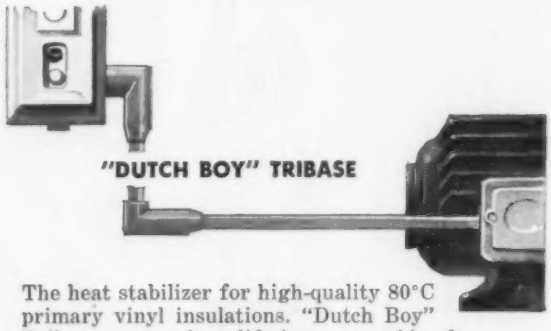
with *five* versatile stabilizers

one for every wire and market



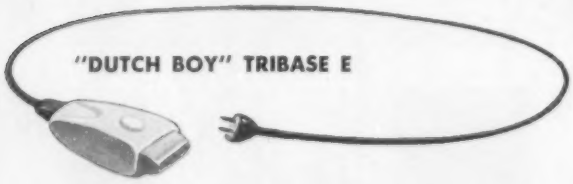
"DUTCH BOY" DYTHAL®

The standard of the industry for stabilizing primary vinyl insulations of the 90°, 105°C class . . . arc-welder cables, TV internals, pyrometer leads, for example. "Dutch Boy" Dythal is compatible with polyesters, disperses easily. It shows excellent tubing characteristics and withstands high extrusion temperatures.



"DUTCH BOY" TRIBASE

The heat stabilizer for high-quality 80°C primary vinyl insulations. "Dutch Boy" Tribase assures long life in power cables for machine tools, soldering irons, appliances, and similar devices. It eliminates gassing, color instability, moisture pick-up. Dispersion and tubing characteristics are both excellent.



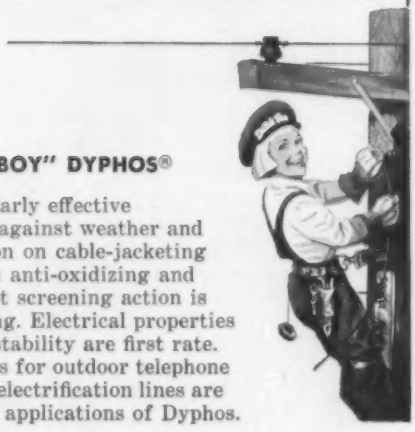
"DUTCH BOY" TRIBASE E

Widely used for flexible SPT-type vinyl cords. Leads for lamps, light-duty tools, Christmas tree lights and other portable appliances are often stabilized with Tribase E. It is one of the best low-volume-cost stabilizers, with excellent general properties.



"DUTCH BOY" LECTRO "60"

Newest of the "Dutch Boy" "electrical" stabilizers, Lectro "60", is outstanding for economy (specific gravity only 4.0) and volume resistivity *plus* excellent water resistivity. It is unique in ease of dispersion and is recommended for sensitive plasticizers. An excellent stabilizer for T and TW wires.



"DUTCH BOY" DYPHOS®

A particularly effective stabilizer against weather and light action on cable-jacketing stocks. Its anti-oxidizing and ultra-violet screening action is outstanding. Electrical properties and heat stability are first rate. Insulations for outdoor telephone and rural electrification lines are important applications of Dyphos.

Maybe the five "Dutch Boy" Stabilizers above can help you improve quality and control cost in making vinyl insulations. Or perhaps you would like information on what other "Dutch Boy" Stabilizers can do for you. Just write National Lead's technical staff.

Dutch Boy® CHEMICALS

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Introducing The "Super Six"

THERMA-FIN EXTRUDER*

One of the more recent additions to Davis-Standard's line of high quality *THERMA-FIN* thermoplastic extruders is the "Super Six". The "Super Six" *THERMA-FIN* Extruder is an enlarged version of the standard 6-inch *THERMA-FIN* Extruder. The "Super Six" has greater heating and cooling capacities, higher rated capacities, and a longer effective screw length than its standard counterpart. Perhaps foremost among the many unique features of the "Super Six" is the excellent temperature control that is provided by Davis-Standard's exclusive *THERMA-FIN* Temperature control system.



Model 600T Davis-Standard *THERMA-FIN* Super Extruder Having 6" Bore. Standard and Super Models Available in 1½", 2", 2½", 3¼", 4½", and 6" Bore Sizes.

SPECIFICATIONS

BORE SIZE: *6 inches*

RATED CAPACITY (at 90 RPM screw speed):

Polyvinyl Chloride – 900 lbs./hr.
Polyethylene – 631 lbs./hr.

EFFECTIVE SCREW LENGTH: *91 inches*

NO. OF BLOWERS: *4*

COOLING CAPACITY PER BLOWER: *920 cu. ft./min.*

TOTAL HEAT RADIATION SURFACE: *14,930 sq. in.*

HEATING CAPACITY:

Head Zone – 3000 W;
Zone 1 – 9500 W;
Zones 2, 3, and 4 – 7000 W each

For catalog sheets or other additional information on ***THERMA-FIN*** *Extruders, write to:*

*U. S. Patents Pending

DAVIS-STANDARD
SALES CORPORATION

22 WATER STREET, MYSTIC, CONNECTICUT

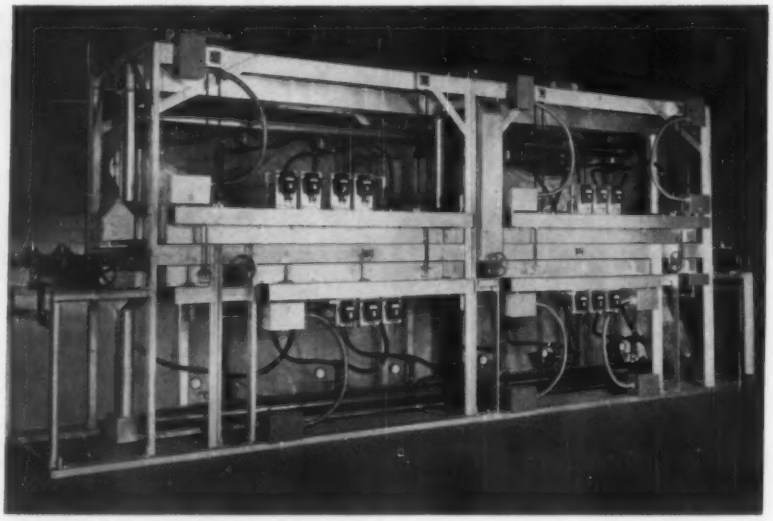
SOLE SELLING AGENTS FOR . . . **THE STANDARD MACHINERY COMPANY,** World's Largest Manufacturers of Custom-Built Extruding Machines IN EUROPE AND THE STERLING AREA, CONTACT FINNEY PRESSES LTD., BIRMINGHAM, ENGLAND

It's hot! Combination VAPO FUSER and Tenter Frame

heat treats and fuses single or double coated web—to a definite width

Temperatures up to 950° F.

Unit shown in operating position. Heater sections retract when web is stopped.



Temperature Range—200°F to 950°F

Electric Heater Capacity — 195 k.w.

Length — 22 ft.

Width — 5 ft.

Height — 12 ft.

Units can be built in any size, to meet customer's requirements.

Can be furnished without tenter frame if desired.

The Dawson Vapo Fuser provides accurately controlled heat that will efficiently handle your most critical jobs. You can cure rubber, and fuse vinyl or other thermoplastic coatings—up to 20 ounces of coating per square yard of bare stock—to any web material. You can cure phenolic resins and extract solvents from coating formulations, too.

Even tension is maintained throughout drying and curing. Result—a perfectly flat, wrinkle-free finish. Special clips hold the web to a predetermined width.

Write for your free copy of the Dawson catalog of curing, drying and fusing equipment.

F. C. DAWSON ENGINEERING COMPANY / Canton, Massachusetts

C I B A

Araldite®
First in Epoxies



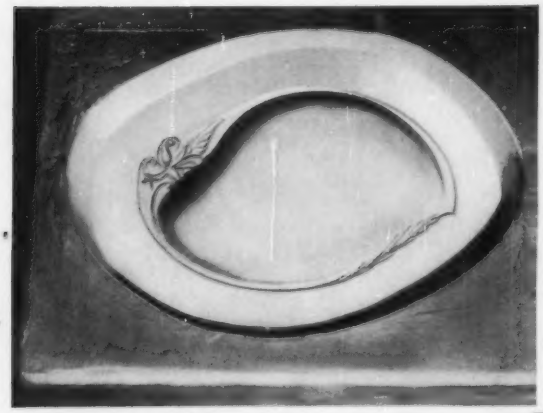
Wherever great strength with light weight, excellent electrical properties, chemical resistance, and an ability to adhere to almost every kind of surface are needed, Araldite "Double Check"* Epoxy Resins are ready to step in with this unbeatable combination of properties unavailable before in one class of basic resins. Results? Case histories like these to point the way to advance your own engineering planning and stream-line production with overall savings in time and money that will bring the all-important "plus" to your profit picture!

SLASHES TOOLING COSTS UP TO 40%!
This die for the forming of airplane part shown is fabricated with a ½" facing of Epoxy Resin over a rough kirksite casting. Time formerly spent on grinding with a blue block is eliminated, and tooling costs are slashed up to 40%.

Formulator: Furane Plastics, Inc.
Customer: Lockheed Aircraft Corp.

LOW COST RETREAD REDEEMS COSTLY DIES!
Details of worn dies, which would cost thousands of dollars to reclaim by former methods, are easily refaced and put back into use by casting Epoxy Resin against a pattern, or actual part. Male punch is faced with a flexible Epoxy formulation.

Formulator: Rezolin, Inc.
Customer: R. Wallace & Sons Mfg., Co.



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Ciba produces basic resins only which are formulated for intermediate and end uses by accredited formulators.

CIBA COMPANY INC., Plastics Division
627 Greenwich St., New York 14, N. Y.

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Please send me full information on CIBA Epoxy Resins for

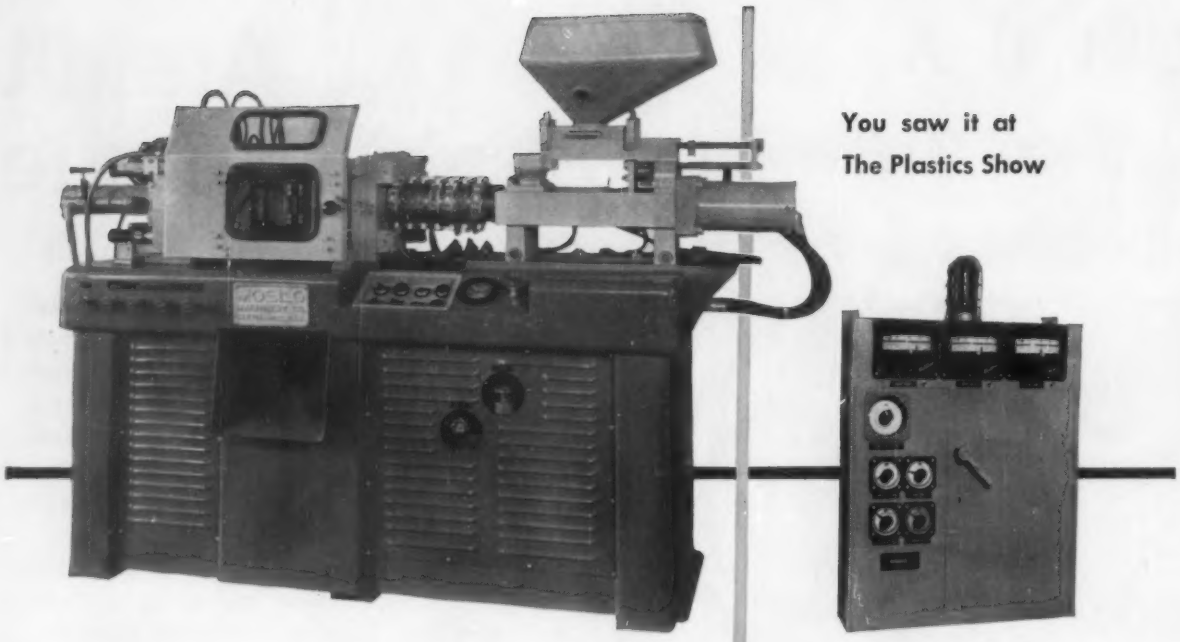
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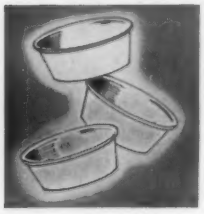
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World's Fastest Injection MOLDING MACHINE

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Moslo machines are proving themselves on *performance* and *economy*.

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More than 900 of these 6-ounce containers were molded per hour from a single cavity.

The Moslo line includes these models, ideally suited for container molding:

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Model 74-12—Super 2 ounce with 12" mold stroke

Model 75-8—High speed 3 ounce with 8" mold stroke

Model 75-15—High speed 3 ounce with 15" mold stroke

Model 76-9—Super 3 ounce with 8" mold stroke

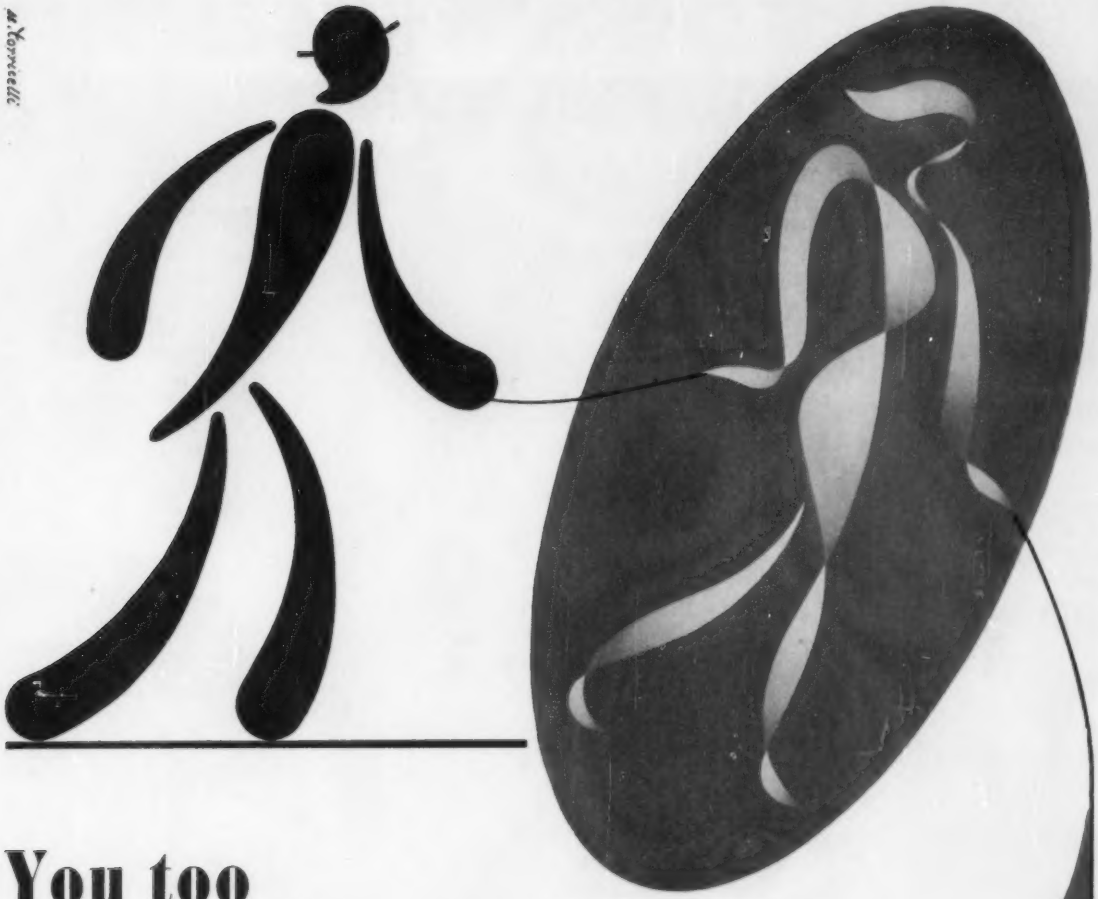
Model 76-15—Super 3 ounce with 15" mold stroke

Models 10 & 11—Famous Duplimatics for insert molding

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800-TON HOT PLATEN PRESS

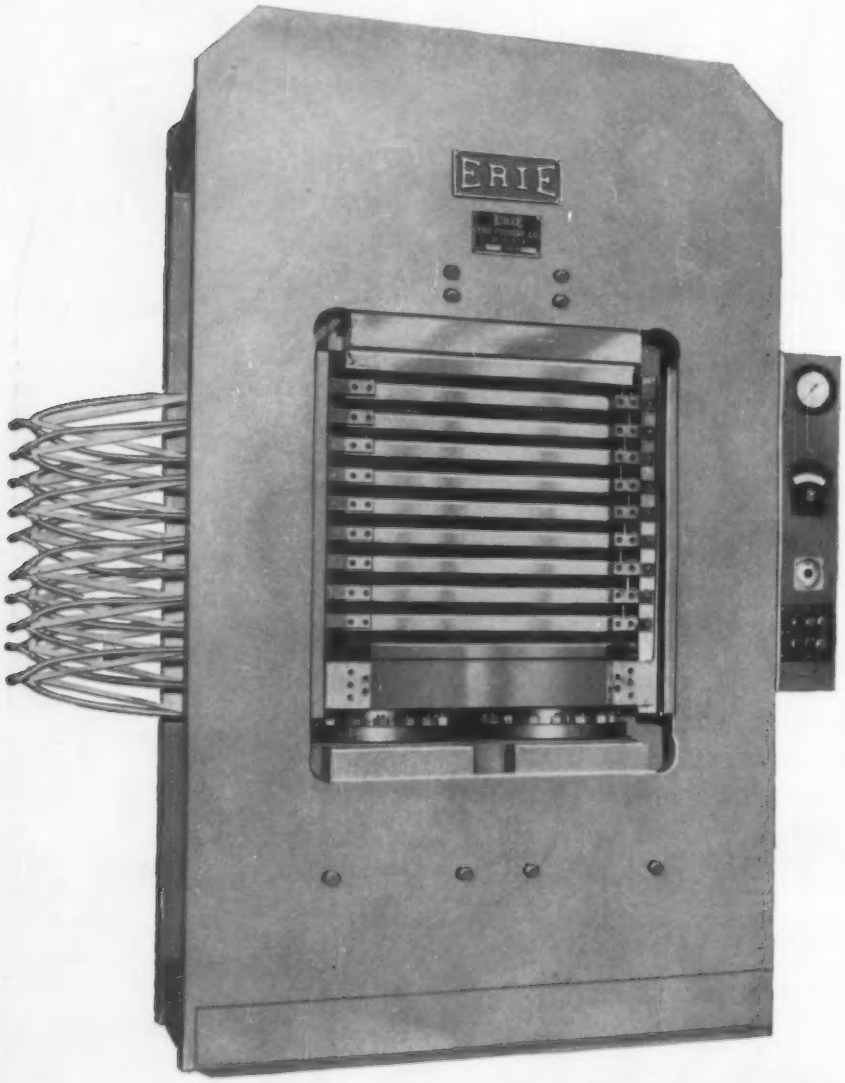
This Erie Foundry hot platen press is designed and built for precision molding. It is compact and rigid, with minimum deflection . . . yet of economical design.

The press is self-contained, with push button control for semi-automatic or manual operation. Platen guides are arranged to provide accurate alignment over the entire range of platen temperatures.

To prevent scoring of the ram, the inserted cylinders are furnished with bronze bushings in gland and stuffing box.

At present, this 10-platen press is being used in the production of printed circuits. It is equally adaptable wherever multiple-opening heated platen presses are required.

For additional information on this press or on the complete line of Erie Foundry rubber and plastic hydraulic presses, just write to: Erie Foundry Company, Erie 6, Pennsylvania.



800-TON
HOT PLATEN PRESS
2 rams 15½" dia. each
Platen size 42" x 24"
10 openings 2" each
Stroke 20"

ERIE
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Hydraulic Press Division
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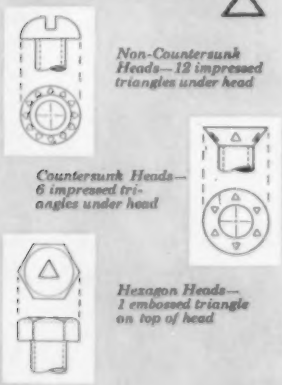
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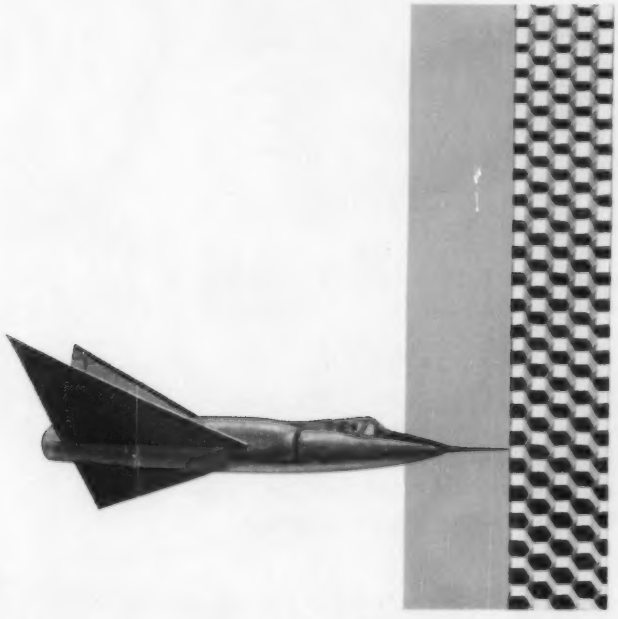
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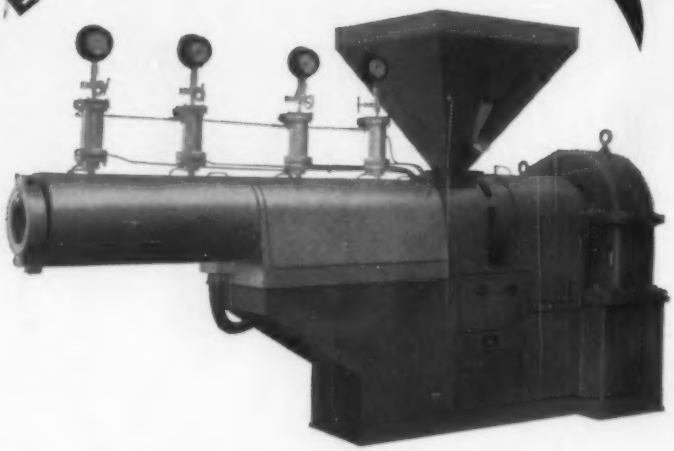
For further information regarding Hexcel Honeycomb core materials write or wire Hexcel Products Inc., 951-61st Street, Oakland 8, California. Branch offices are located at: 1025 W. Arbor Vitae Street, Inglewood 1, California; Havre de Grace, Maryland; and 3309 Winthrop Avenue, Fort Worth, Texas.

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This *Egan* designed system automatically eliminates problems of overheating due to excessive frictional heat. It is completely automatic—No moving parts—No need for operator to determine whether cooling should be "on" or "off"

*Patent applied for

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Standard *Egan* extruders for thermoplastics, in production use throughout the free world, have been designed for maximum flexibility and incorporate all the features important in extruder design.

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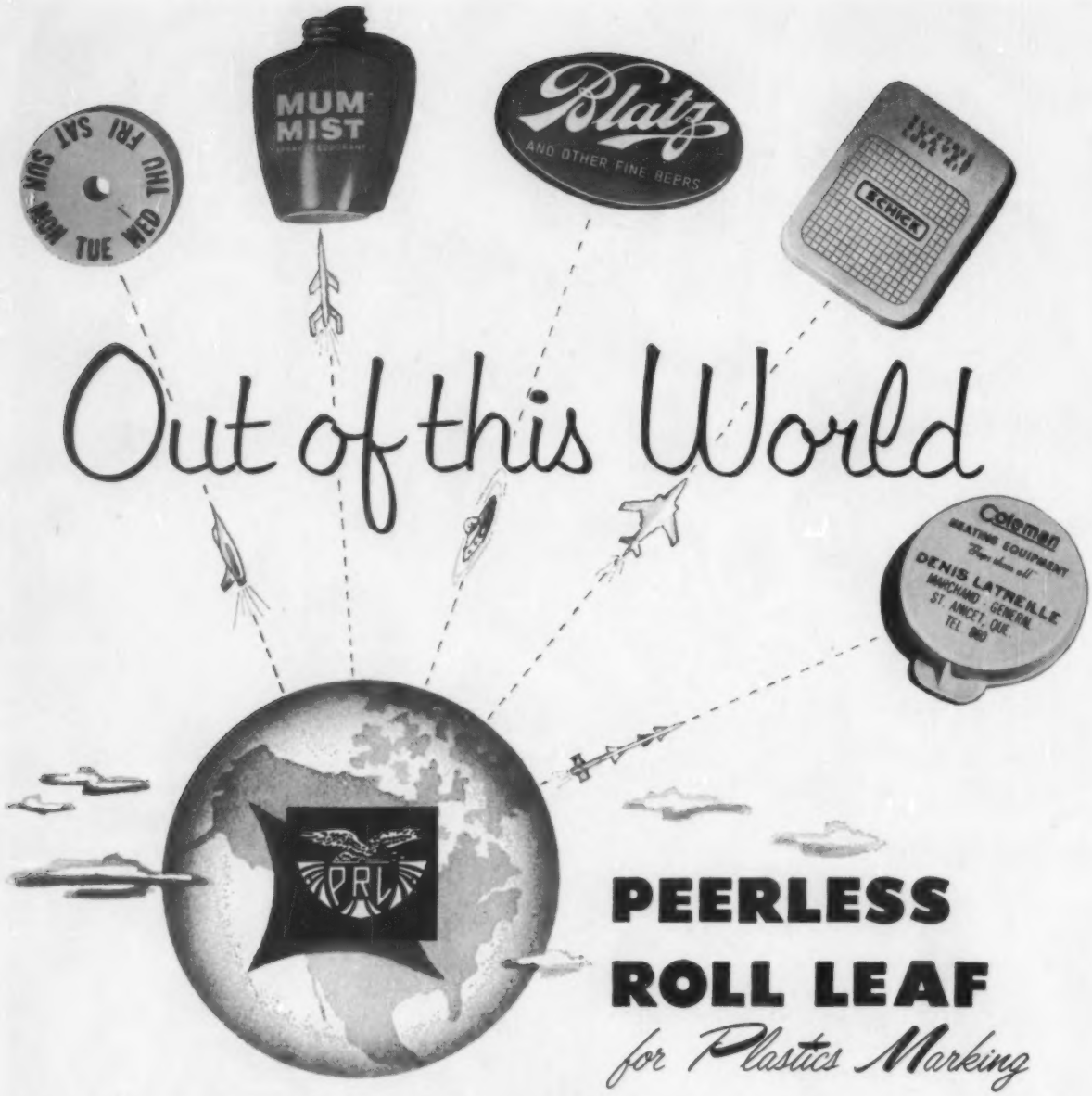
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PEERLESS ROLL LEAF

for Plastics Marking

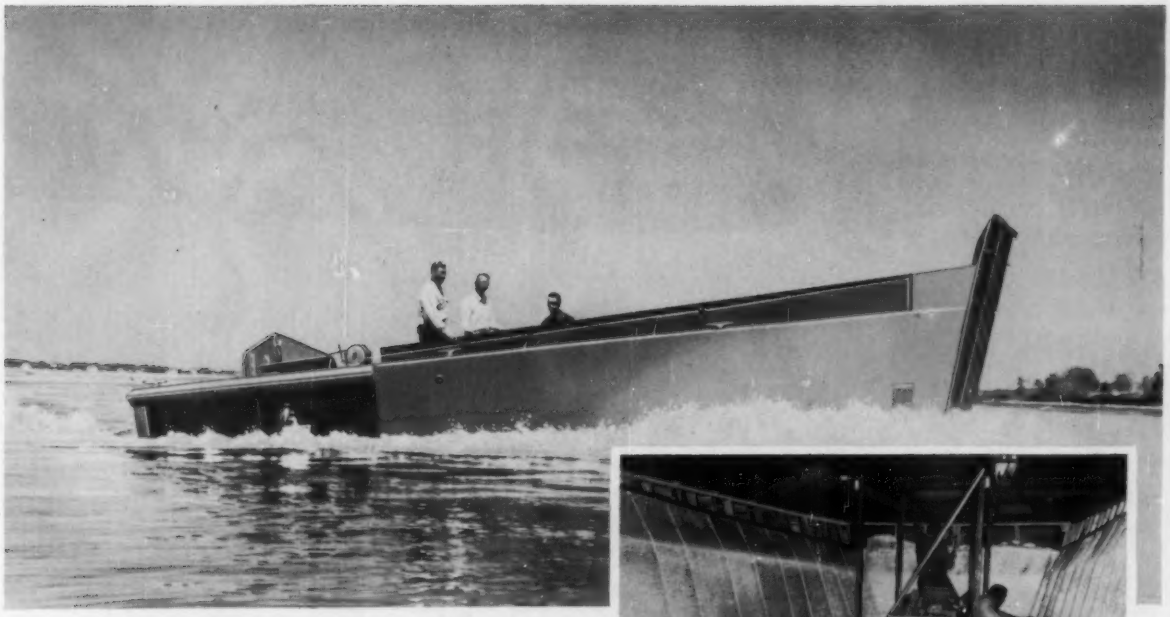
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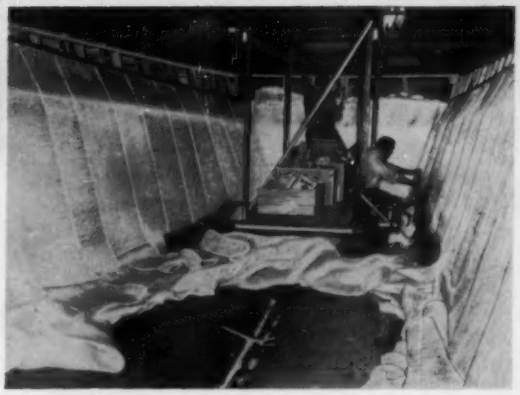
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For the Navy's famous LCVP, rugged workhorse of the amphibious forces, a better hull was the "order-of-the-day." The new hull had to be non-corrosive, more durable, have greater impact strength . . . and still be more economical to maintain! A tall order —but one that Lunn Laminates, Inc. successfully executed by selecting Bigelow for its record of accomplishment in the fiber glass field.

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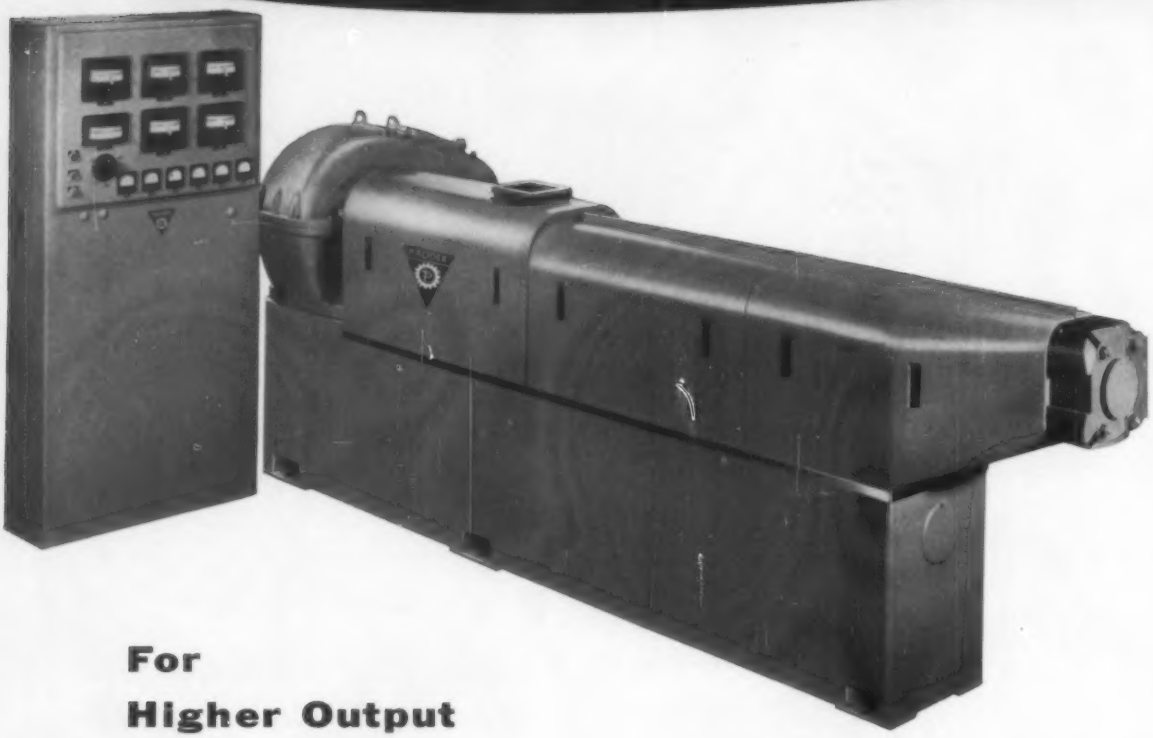
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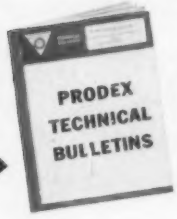


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Through years of continuous operation, Prodex Extruders have proven that they produce more pounds per hour of better quality extrusions.

Available with Le/D ratios of 16:1, 20:1 and vented 24:1 in 2½", 3½", 4½", 6" and 8" sizes. Get the full facts. New technical bulletins No. E-2 and E-3 provide full details.

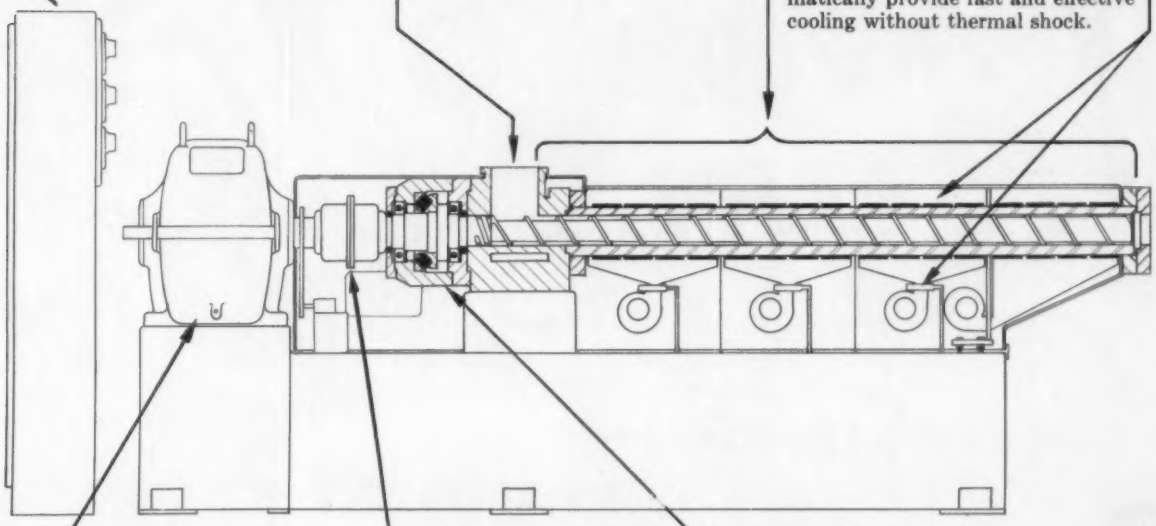
Investigate Today

Completely Wired Control Cabinet
Contains all temperature controllers, individual zone ammeters, contactors with pilot relays, individual fuses for each circuit. Built to strict JIC standards with harness wiring and terminal strip construction. Gasketed and dustproof.

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Produces extrusions of superior appearance to closer tolerances and 20% to 40% faster. Advanced screw and barrel design guarantee maximum drag flow and pumping action.

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No compound bridging.

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Electronic three position temperature controllers automatically actuate stainless steel heaters and turbo air coolers for precise temperature control. Triple density heaters permit choice of wattage density best suited to operation to avoid hot spots. High capacity blowers automatically provide fast and effective cooling without thermal shock.



Herringbone Gear Transmission
Chosen because of superior efficiency and durability over worm gear drives. Pre-hardened steel gears and roller bearings used throughout.

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This coupling between gear transmission and thrust bearing protects gear transmission from mechanical shock. Permits easy thrust assembly inspection and maintenance without affecting alignment.

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The extra heavy thrust bearing is of the spherical roller type. Drive shaft and thrust bearing are supported by two widely spaced radial bearings. Assembly is force lubricated by continuously filtered oil.

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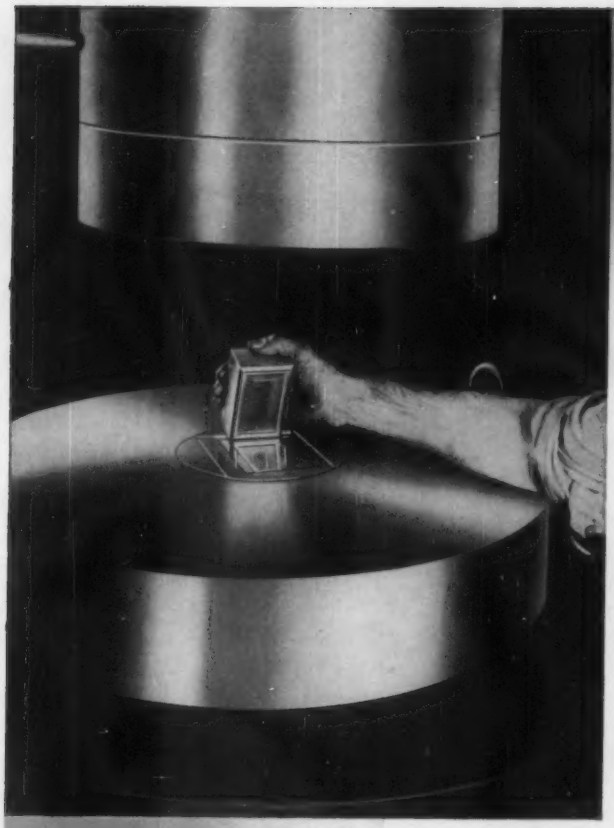
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MARBON CHEMICAL . . . ***Precision Resins for Precision Made Products***



PENCIL CAVITIES HOBBED IN SOLID STEEL



MOLDED PIECES



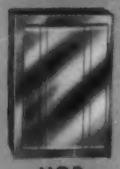
HOBBED CAVITY



HOBBED CAVITY CUTAWAY VIEW

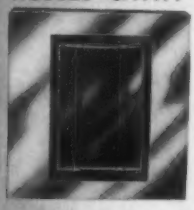
SKILLED HANDS *AND* GIANT PRESSES

combine to turn out consistently accurate hobbed cavities



HOB

HOBBED CAVITY





HOB



HOBBED CAVITY

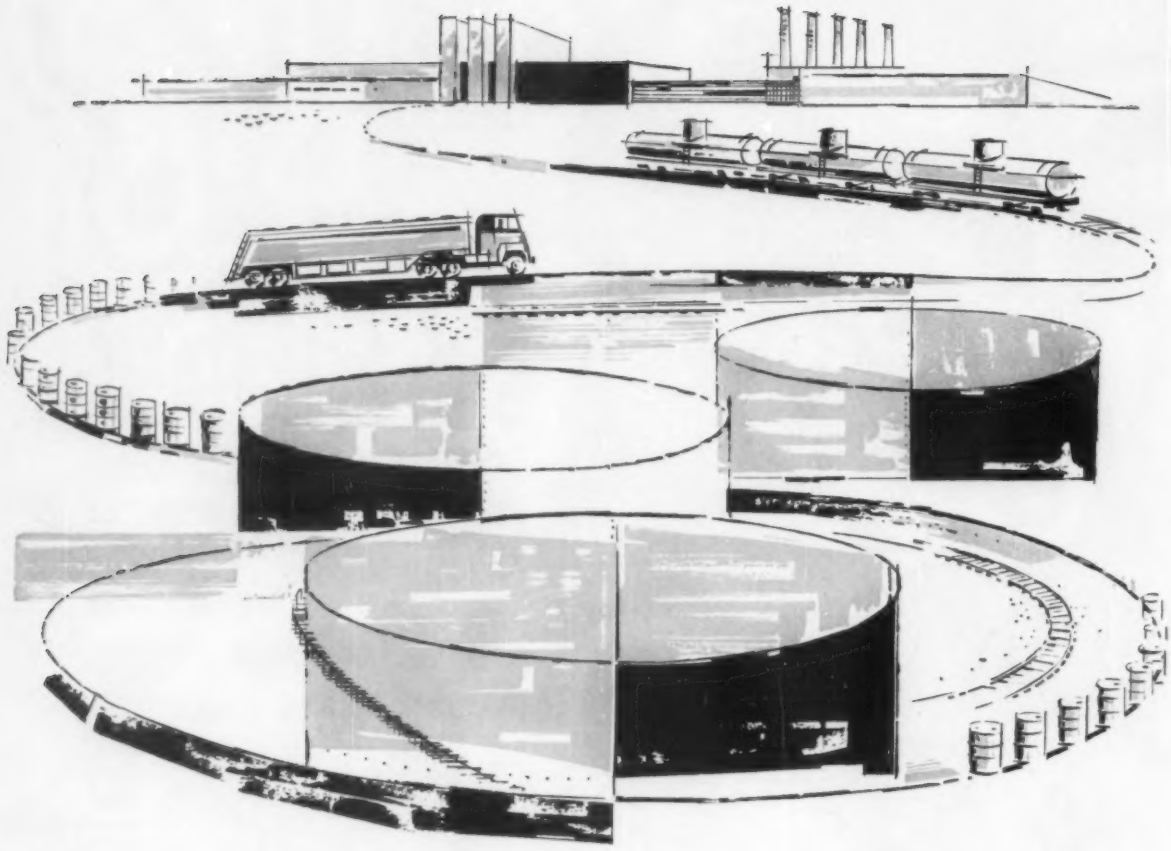
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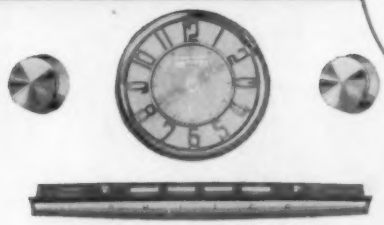
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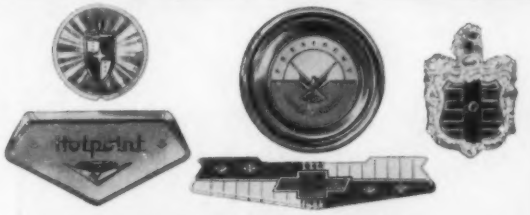
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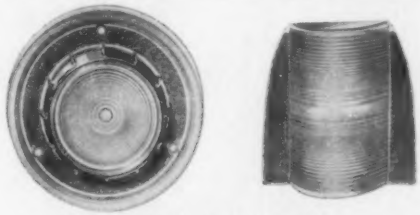
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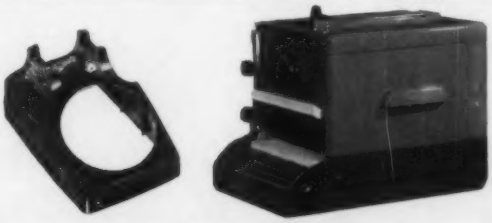
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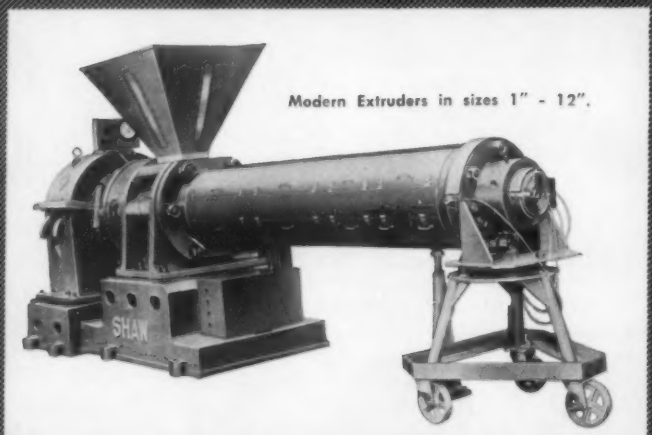
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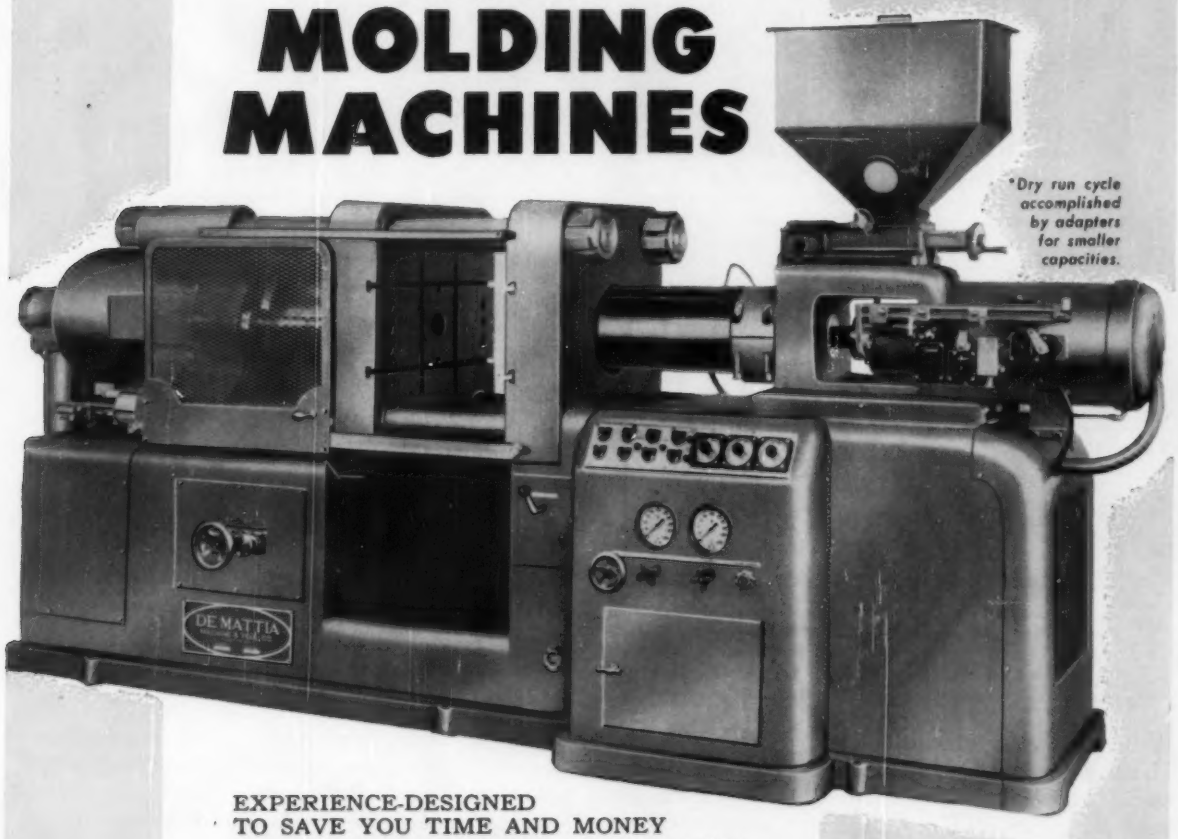
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*Dry run cycle accomplished by adapters for smaller capacities.



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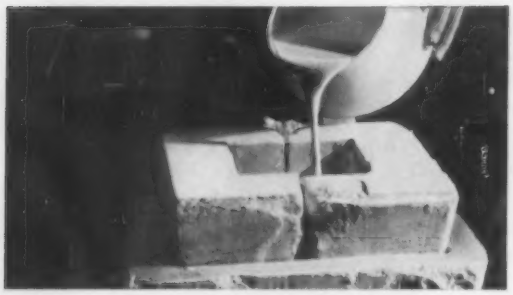
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HOW VERTOL AIRCRAFT FORMS HOLLOW PLASTIC AND NEOPRENE PARTS WITH NEW BESTWALL BREAKAWAY PLASTER





Here Bestwall Breakaway Plaster is being poured into a plaster mold at the Vertol Aircraft Corporation plant at Morton, near Philadelphia. This is the first step in making an expendable Breakaway mandrel on which a polyester laminate compass support will be formed.



Another use for Breakaway Plaster at Vertol. A Breakaway mandrel, used to make a neoprene power plant control boot in a Vertol H-21C Helicopter, is removed from a rubber forming mold. Molds for casting mandrels of Bestwall Breakaway Plaster may be of metal, wood, rubber or plaster.



Workman applies parting agent to Breakaway Plaster mandrel to prevent adhesion of the plaster to the neoprene part. Lighter pieces in background are the plastic laminates applied over the mandrels. Darker pieces at the right have been coated with neoprene and are ready for curing.



Here the Bestwall Breakaway Plaster is being washed out of the molded power plant control boot after the curing operation. Water at 170° F. quickly flushes the expendable Breakaway mandrel from the most intricate shapes without malforming or breaking the part.

Bestwall's new, improved Breakaway Plaster is a gypsum base composition specially formulated for the production of hollow shapes formed of glass fiber mats reinforced with resins. With this new formula, excellent results can be obtained more quickly and easily, and at less cost than ever before.

Before switching to Bestwall Breakaway Plaster, Vertol Aircraft Corporation used a material which had to be manually broken out. This sometimes caused a breaking or malforming of the part and resulted in waste and higher manufacturing costs.

Breakaway Plaster can be quickly and easily *washed* out of the most intricate shapes with hot water or steam. It is readily adaptable to any contour.

Whatever your requirements, Bestwall and its distributors are ready to work closely with you, and to recommend the specific industrial plaster that will improve your product or raise your plant efficiency.

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This 8-page bulletin gives complete physical and chemical properties; principal reactions of the carboxyl and alpha methylene groups; solubility curve, suggested uses and literature references. Working samples and quotation on request.

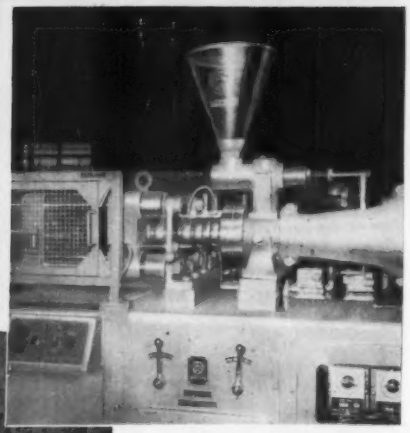
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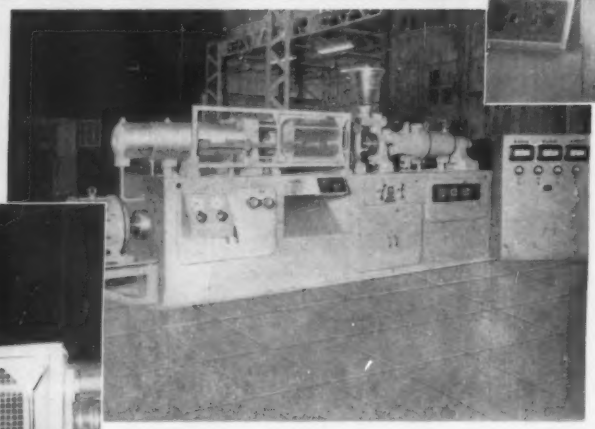
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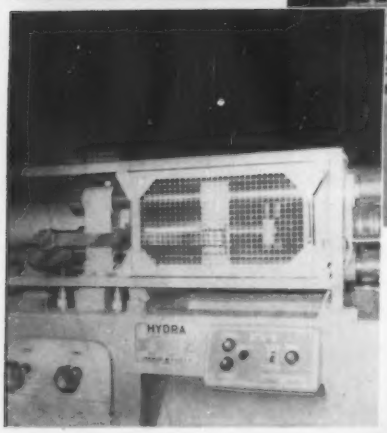
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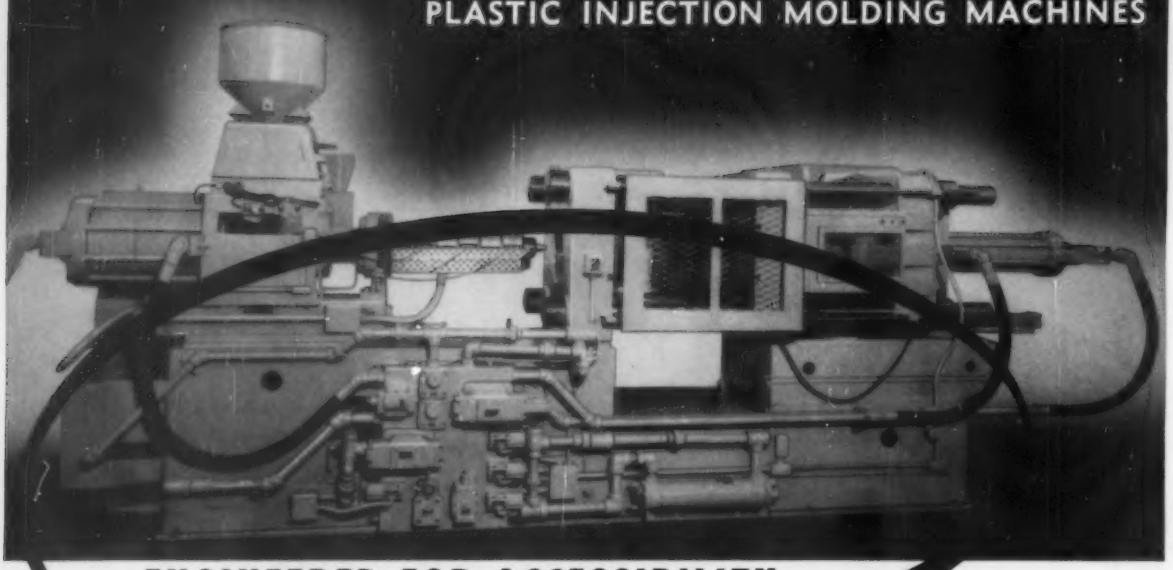
The first product—a general purpose, easy processing Polyvinyl Chloride Resin—will be in production this year for use in the calendering, extrusion and molding industries. Following this, Escambia will produce a molecular weight range of straight PVC Resins including types for electrical and rigid applications.

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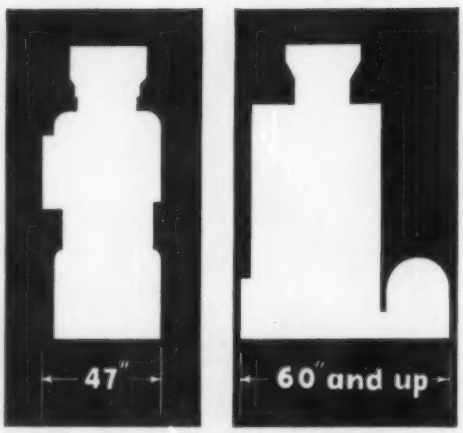


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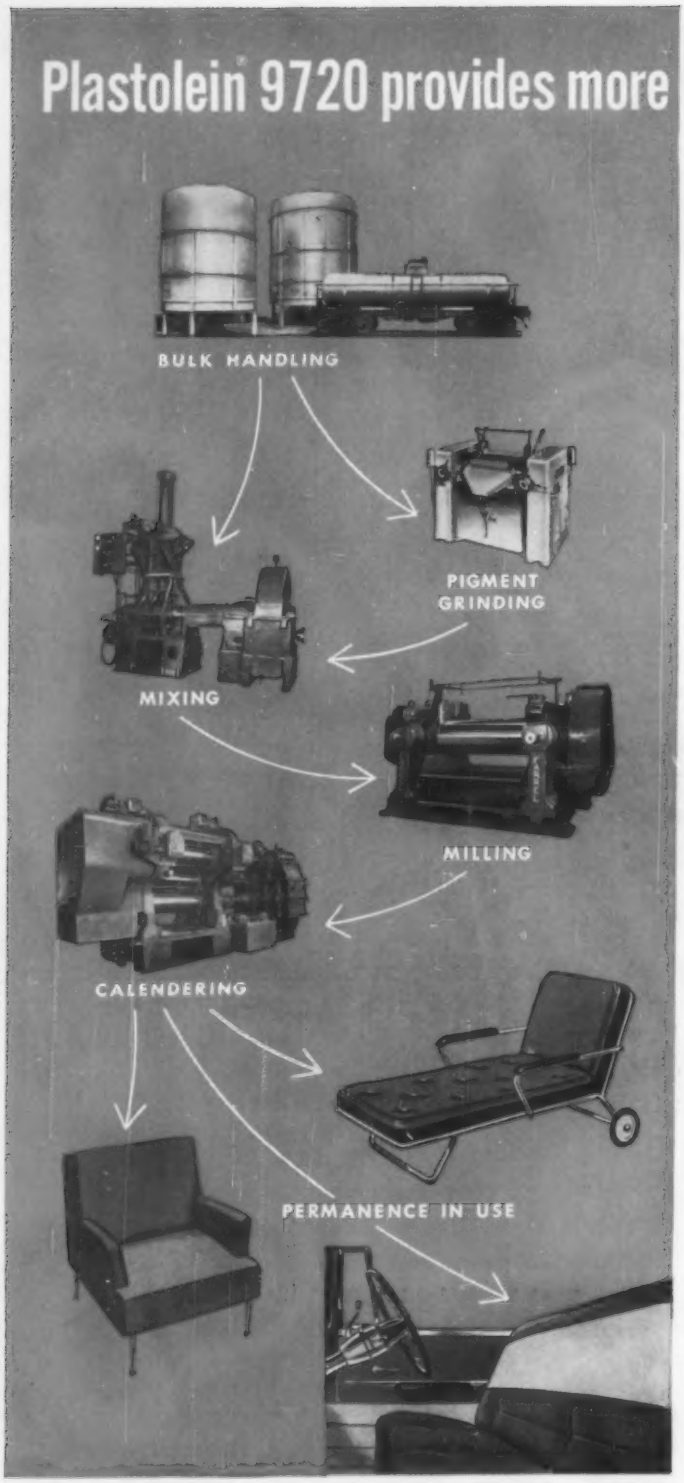
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MODERN PLASTICS
Volume 34
October
1956
Number 2

Polyethylene meets new markets with KING-SIZE MOLDINGS



Fig. 1: Biggest polyethylene molding to-date: 22-gal. can. (Photo, Loma Plastics, Inc.)

The interesting phenomenon of market preconditioning is bringing about a development in polyethylene use which is expected by several of the molders involved and by at least two materials makers to result in the use of polyethylene in housewares at a rate of 100,000,000 lb. a year by the end of 1956.

The simple fact is that small polyethylene housewares have been enormously successful and have been approved and appreciated by housewives because of sound design and quality production. When the big moldings came in, favorable market opinion awaited them and in the past 12 months their growth in volume has amazed almost all concerned.

That the city of New York is studying the proposition of replacing metal trashcans with polyethylene units because of noise abatement alone is only slightly cogent to this matter, regardless of the numbers involved. The factors more important to the housewife are lightness in weight, unbreakability, undentability, easy cleanability, freedom from corrosion, and permanent color.

That this market for king-size polyethylene buckets, garbage pails, trash containers, dish pans, baby baths, and laundry baskets has almost explosively confounded the most optimistic and enthusiastic market researchers is a slightly embarrassing but most pleasant fact. Just a year ago Monsanto Chemical Co.'s Market Development Dept. completed a survey and made estimates on future housewares markets for styrene and polyethylene. These researchers used the expression "big ticket" in referring to large polyethylene housewares, because that is a retail term referring to more



Fig. 2: Laundry basket can double as baby's bathtub, holds 42 qt., requires no liner. (Photo, Loma Plastics, Inc.)

Laundry Baskets



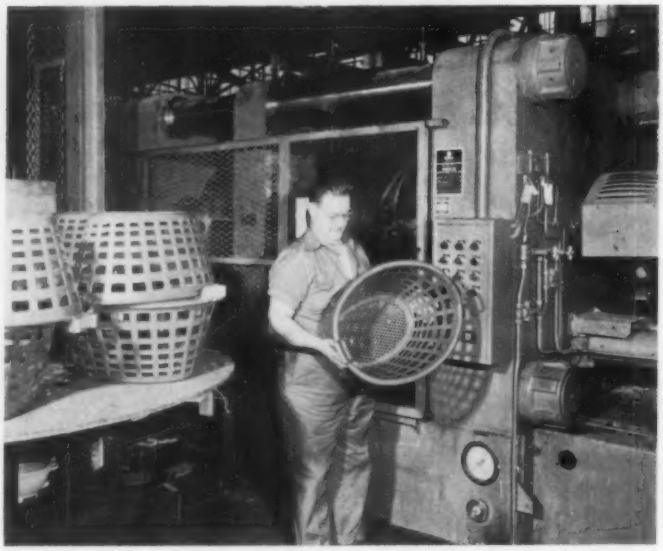


Fig. 3: King-size basket (top right) is designed to provide ventilation for laundry. At right is machine on which these baskets are injection molded. (Photos, top right—Eastman Chemical, right—Hydraulic Press Mfg. Co.)

expensive merchandise. Here are Monsanto's estimate figures:

	Millions of lb.					
	1952	'53	'54	'55	'56	'57
General housewares						
Styrene	50	59	46	44	42	42
Polyethylene	5	7	20	28	33	38
"Big ticket" polyethylene	4	5	9	26	29	32
Total polyethylene	9	12	29	54	62	70
Total plastics	59	71	75	98	104	112

From four million lb. of polyethylene in big housewares moldings in 1952 to 26 million lb. in 1955 is a meteoric market rise indeed. But the estimates for 1956 and 1957 were made a year ago and by far the greatest development, as mentioned above, has happened since then.

Out of the hundred million lb. of polyethylene a year soon to be used in housewares, it now seems probable that more than half will be used in pieces weighing from 3 to 10 or 12 lb. each. The dollar significance of this is indicated by the same piece of Monsanto research which showed that an average retail price/lb. of molded polyethylene housewares amounts to $2.04, while a pound of finished styrene housewares averages $1.95 at retail. In view of the fact that the big polyethylene pieces now account for more than 25% of the weight of all plastics going into housewares, this new market in retail dollars would account for 30% of the business.

The key, of course, is that most of these products compete with metal, not with other

plastics. And every time there is a strike in the metals industries and steel and other metal prices go up, plastics, coming down in cost, march further into the markets traditionally dominated by metals—with polyethylene leading the parade.

The attraction of these big moldings for the housewife is easily understood. From the standpoint of the molder, these king-size items also have a great deal to offer. Such deep-draft, large-area items are a "natural" for the many high-capacity injection machines now installed in molders' plants throughout the country. According to MODERN PLASTICS' annual machinery sales tabulations, as reported in the January 1956 issue, nearly 200 injection machines ranging in capacity from 30 oz. upward were shipped for domestic installation during the 1952-1955 period.

Products prove the point

A number of the "big ticket" items being currently produced of polyethylene by the injection molding process are illustrated herewith. Although by no means all-inclusive, this group of products indicates some of the principal design trends and also points up the fact that a number of these products involve large quantities of molding material.

A 22-gal. noiseless trashcan (Fig. 1, p. 123) recently introduced by Loma Plastics, Inc., Ft. Worth, Tex., stands 27¾ in. high and 20½ in. across, and weighs 7 pounds. Retailing at $12.98 at hardware and department stores, the molded polyethylene container comes in four colors. Amazingly sturdy, it will spring back into shape even when run over by a truck. Despite its size, however, the can is easily carried with two fingers. An exclusive feature is the lock-lid cover and 360° "all-around" handle; the rim is so molded as to form a handle all around the top edge for ease in moving. The lock-lid cover prevents foraging animals from opening the can in quest of food.

Also produced by Loma is a new carry-all laundry basket of many uses (see Fig. 2, opposite). Measuring 28½ in. long, 19 in. wide, and 14½ in. high, the basket will hold 35 lb. of wet

Garbage Cans



Fig. 4: Molded garbage can incorporates molded liner, foot-operated lid. (Photo, Monsanto)



Fig. 5: Lid with lock-fit handle seals outdoor garbage can, keeping odors in, stray animals out. (Photo, The Plas-Tex Corp.)

wash without overloading. Drip-proof, snag-proof, and guaranteed unbreakable, the Loma "Tote Basket" also doubles as a baby bathtub and is useful for many household storing and cleaning assignments. Easy-to-grasp handles make the basket convenient to use.

A somewhat different approach has been followed by Columbus Plastic Products, Inc., Columbus, Ohio, in designing a new molded polyethylene laundry basket. The Lustro-Ware basket, also produced by the injection molding process, incorporates an open, basket-weave design and a perforated bottom for drainage of water from wet clothes. Oval in shape, the basket measures 24 in. long, 18 in. wide, and 11¼ in. high. Large, comfortable handles at each end of the basket are molded integrally with the extra strong flanged top rim of the basket. The smooth surfaces of the basket cannot snag even the most delicate fabrics and the integral color cannot wear off or stain wet clothes. Retailing at $3.95, the laundry basket (see Fig. 3, p. 124) is available in three different colors.

Among the numerous step-on type plastic garbage cans now on the market is a versatile new three-piece molded polyethylene unit made by Dapol Plastics, Inc., Worcester, Mass,. shown in Fig. 4, p. 125. Retailing at $4.98, the Dapolite Step-On Can consists of an outer container in one of five colors, a removable liner of 8-qt. capacity, and a pedal-operated cover molded of white polyethylene. Light in weight and easily cleaned, the disposal can will not mar furniture or floors. It cannot leak, since the liner is molded in one piece without seams. The unit is ideal for use in nursery or sickroom since the closing of the plastic lid is practically noiseless.

Among the guaranteed unbreakable molded polyethylene housewares items produced by The Plas-Tex Corp., Los Angeles, Calif., is the G-Can, a 10-gal.-capacity container featuring a dogproof, odor-sealing lid with a Lock-Lift handle "that really locks," as shown in Fig. 5, p. 125. Carrying a suggested retail price of $7.98, this popular big ticket item is equipped with a free-swinging, cadmium-plated bail secured to the body of the pail by means of sturdy metal supports. It is made in a choice of six colors.

Dish Pans

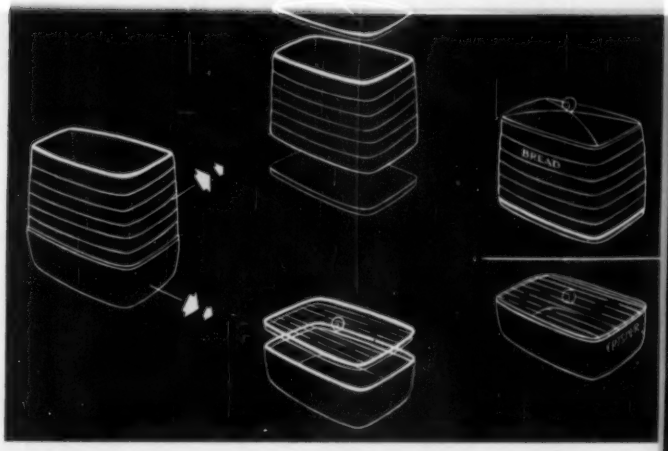


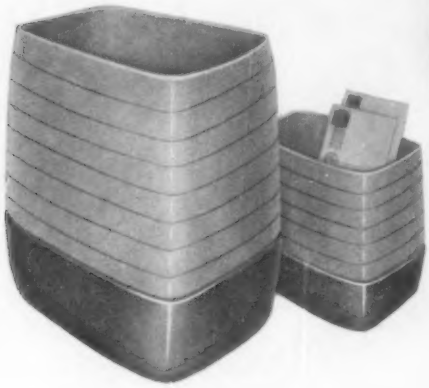
Fig. 6: Rectangular dish pan fits standard sinks, has convenient hang-up hole molded into rim. (Photo, Spencer Chemical Co.)

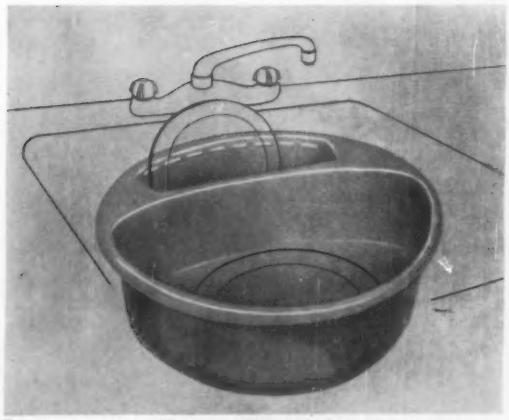
Molded polyethylene basins, wastebaskets, and dish pans, in that order, are currently the best selling polyethylene housewares items. The fact that a soft polyethylene dish pan, unlike a metal dish pan, cannot scratch or mar enamel sink surfaces is a big point which appeals to housewives. The plastic dish pans are also extremely light and easy to handle and are available in a wide range of colors to harmonize with other kitchen accessories. Many are made with a hole in the top edge so they may be hung up when not in use. The dish pan molded by Wooster Rubber Co., Wooster, Ohio, shown in Fig. 6, left, is square, for ease of use.

Molded polyethylene wastebaskets offer many of the same selling points. Even when used in a damp location, such as a bathroom, they cannot rust or stain the floor or wall. Any type of empty container, including glass bottles or metal cans, may be tossed into them without startling everyone in the house. And, of course, they can be easily cleaned with soap and water, retaining their bright integral colors throughout their long life. Improved styling, in addition to larger sizes, is an outstanding trend in

New Design Ideas for Big Polyethylene Pieces







Drawings courtesy Monsanto Chemical Co.

To further stimulate the marketing of polyethylene in the form of large molded housewares, Monsanto Chemical Co.'s Plastics Div. asked Richard Neagle Associates of Philadelphia to study the design possibilities in this market.

Above and at top left is a suggestion wherein one set of molds can create components for four or more items, with resulting economies in mold costs.

Center left is a dish pan with a water-saving wash-rinse feature and an overflow rinse drain. The product would be 15 in. in diameter by 6 in. deep to fit the diameter of the average sink and to accept stacks of average 10 in. diameter dinner plates.

Lower left is a wastebasket design involving two-tone styling and, again, dual proposition tooling. This unit has the advantage of a molded-in carrying grip.

At lower right is the Neagle design for a baby bathtub with soap and cloth tray and a non-slip bathing surface. The design was based on research at Temple Hospital and St. Christopher's Children's Hospital in Philadelphia as to the actual bathing needs of infants.





Buckets and Pails



Fig. 8: Pouring pail with removable lid. (Photo, Monsanto)



Fig. 9: Molded polyethylene "old oaken bucket." (Photo, Eastman Chem.)



Fig. 10: Double-wall polyethylene ice bucket. (Photo, Eastman Chemical)



Fig. 7: Bail on 14-qt. molded pail has polyethylene grip. (Photo, Eastman Chemical)

connection with the polyethylene wastebaskets. They are now available in a wide variety of shapes to fit all requirements—round, oval, and rectangular. At least one molder has even introduced a basket which fits snugly into a corner and is rounded on the front side. Ribbing, beaded edges, and molded or stamped decorations near the top are among the methods being used by molders to give these polyethlyene products added beauty as well as sales appeal.

Polyethylene pails are another "big ticket" item growing rapidly in public acceptance. One excellent example is a 14-qt. pail produced by Wooster Rubber and shown in Fig. 7, left. The rectangular design of this pail makes it suitable for a great variety of uses; it serves efficiently as a soft-drink cooler, a fruit and vegetable bin, a picnic carry-all, a noiseless scrub bucket, a refuse container, or a diaper pail. The bucket alone retails at $2.98; with lid, the price is $3.79. The metal handle, mounted to a wire collar encircling the pail beneath the flanged rim, has a comfortable hand grip of molded polyethylene. The handle may be easily removed to convert the pail into an attractive wastebasket.

A polyethylene pouring pail offered by Plas-Tex Corp., shown in Fig. 8, above, has an optional lid and is suggested (*To page* 258)



USS Worchester under protective water screen during atomic maneuvers. (Official U.S. Navy photos)

Showerbaths for warships

Washdown system to remove radioactive particles with seawater uses vinyl pipe because of its light weight and corrosion resistance

By M. Malamut, W. R. Graner†, and J. J. Kearns‡*

Plastics pipe for use in sprinkler systems for watering lawns, golf courses, farmland, and so forth, has become a standard and accepted item of commerce. Now, the Navy has come up with a sprinkler system of its own, literally to provide showerbaths for its ships of war. While the title of this article may appear to be somewhat frivolous, the Navy's intent, as always, is anything but; the purpose of these showerbaths is to maintain the effectiveness of the Fleet and protect its personnel under wartime conditions of radioactive fallout. The purpose of the sprinkler or washdown system is to surround the ship with a continuous spray of water in a predetermined pattern which, it has been found, will wash radioactive particles overboard and thus provide an effective shield for the ship and its crew. The present plan is to equip most ships in the Navy with such systems at an early date.

*Marine Engineer, Machinery Arrangements & Piping Systems Branch, Bureau of Ships
†Materials Engineer, Plastics & Dielectrics Branch, Bureau of Ships
‡Radiological Safety Engineer, Damage Control, Ship Salvage & Personnel Protection Branch, Bureau of Ships

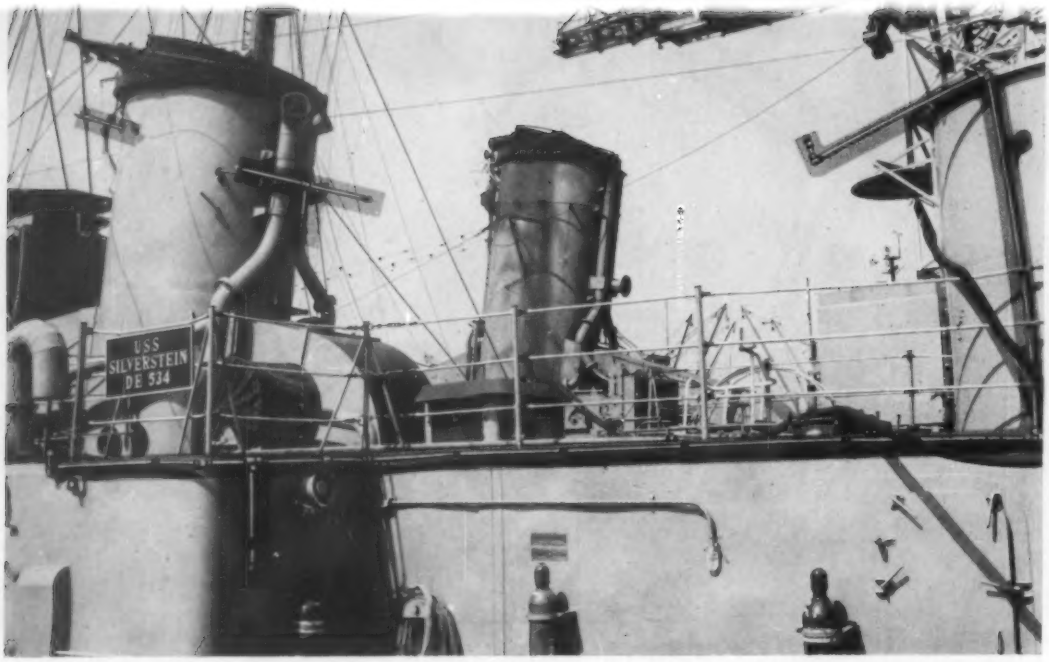
In 1954, the Bureau contracted with Grinnell Corp. for the development and installation of a prototype washdown system. One of the first problems which arose, of course, was the choice of piping materials. After some consideration, it was decided to make three trial installations, one each of steel, aluminum, and plastic for service evaluation and comparison.

Considerations which would govern the final

Table I: Comparison of pipe material weight and cost

Material	*Relative weight*[1]	*Relative cost*[1]
PVC	1.00	1.00
Aluminum	1.12	0.98
Steel	2.54	0.47

[1]PVC = 1



choice of piping material included: 1) lowest weight (most important since this is a top-side installation and if excessive could affect the stability of ships); 2) ease of assembly; 3) ruggedness (resistance to impact); 4) cost; 5) non-flammability; 6) availability (of both pipe and fittings); 7) durability (resistance to corrosion by sea water and weather).

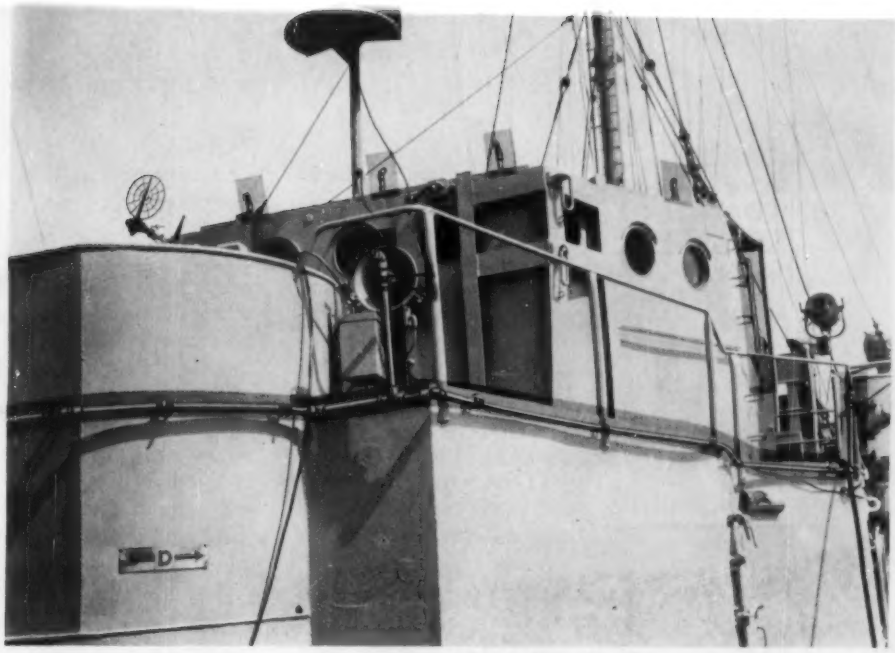
The Navy had previously installed some high-impact polyvinyl chloride piping in the salt water systems of a minesweeper. This installation has proved satisfactory. The decision to use high-impact-grade polyvinyl chloride in the plastic washdown system was, therefore, based on this rather limited experience plus our general knowledge of the characteristics of this type of material which includes, among others, outstanding toughness, fire resistance, and relatively good outdoor weathering characteristics.

Although the washdown system need withstand only an intermittent maximum working pressure of about 100 p.s.i. and a test pressure not to exceed 150 p.s.i., the decision to use Schedule 120 pipe reflects an additional margin of safety. Near the ship's stacks, where temperatures might prove excessive, and in positions where a portable array was necessary, it was decided to use aluminum. Since the Navy prefers to avoid threaded type connections because of poor shock resistance, socket-type fittings were used with a solvent-type PVC cement. All pipe used to date in this application has been made of Geon 8700A rigid high-impact resin. Materials specifications are being prepared by the Bureau of Ships. At the present time, in the absence of a materials specification, any material used must be capable of producing a pipe which will meet all of the pipe performance requirements of MIL-P-19119 as discussed later in this article.

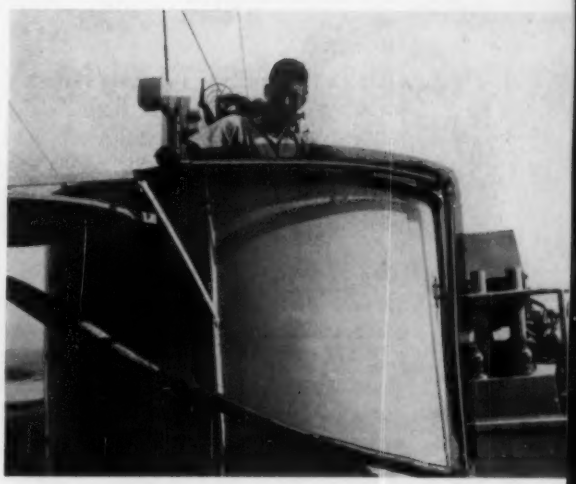
The three initial prototype systems have been installed on identical destroyers and have been in service for over a year. Comparison of these systems is given in Table I, p. 129. It can be seen that the plastic system, although somewhat more expensive than the aluminum system, offered significant weight savings. In addition, the plastic system is completely inert to

Table II: Dimensions and tolerances for qualified pipe

Nominal size	O. D.	Allowable variation of O. D. dimensions		Wall thickness		
		Plus	Minus	Minimum wall	I.p.s. average wall	Maximum wall
in.	in.	in.	in.	in.	in.	in.
¾	1.050	0.005	0.015	0.160	0.170	0.185
1	1.315	0.005	0.015	0.190	0.200	0.215
1¼	1.660	0.005	0.015	0.205	0.215	0.230
1½	1.900	0.005	0.020	0.215	0.225	0.245
2	2.375	0.005	0.020	0.240	0.250	0.270
2½	2.875	0.005	0.020	0.290	0.300	0.325
3	3.500	0.005	0.025	0.340	0.350	0.380



Washdown system for warships consists of high-impact vinyl pipe and fittings (indicated by color areas in photos on these two pages) installed around ship to provide continuous spray of protective water



sea water and is easier to install. The only tools required for its installation are a saw and a paintbrush; the metal pipe and fittings require thread cutting equipment, etc.

Plastic washdown systems have now been installed on some 24 ships of all types and sizes which have been in service all over the world.

Qualification requirements

At the present time, the Navy is qualifying suppliers of high-impact PVC pipe under Military Specification MIL-P-19119 (SHIPS). It is anticipated that some 10 to 15 suppliers will soon be listed on the Qualified Products List for this specification. To qualify, the pipe must meet the following requirements:

a) Dimensions and tolerances as listed in Table II, on facing page.

b) Short-time hydrostatic burst pressure of 1000 p.s.i. minimum at room temperature and 500 p.s.i. at 145° F.

c) Hydrostatic burst of 900 p.s.i. minimum after being subjected to 500 p.s.i. for 24 hours.

d) Hydrostatic burst of 900 p.s.i. minimum after being subjected to a pressure cycling test of six cycles per hour between 0 and 500 p.s.i. for 7 hours.

e) Withstand the impact of a 4-in.-diameter steel ball weighing at least 9.3 lb., dropped from a height of 10 ft., for the number of blows listed in Table III, p. 132. This is considered a most valuable quality control test since the impact resistance seems to be highly sensitive to variations in compounding and extrusion conditions. However, there is some feeling that this

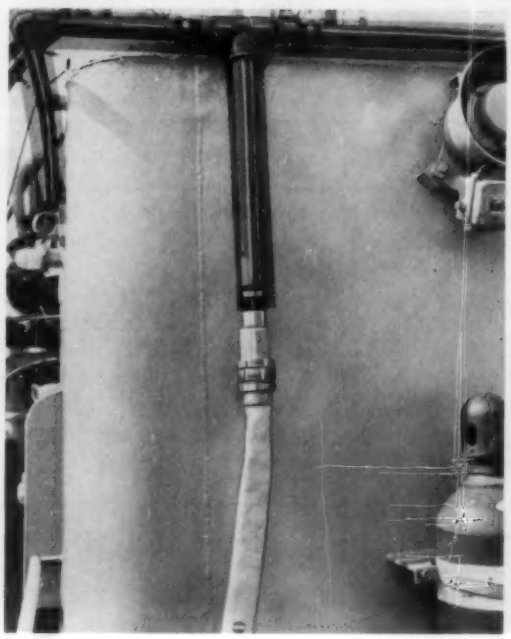


Table III: Drop ball impact test requirements

Nominal size	*Number of blows*
in.	
¾	1
1	2
1¼	3
1½	4
2	7
2½	10
3	15

test may induce fatigue in the material. A new one-drop impact test is under consideration.

f) Be capable of being bent 90° around a cylindrical form having the diameter specified in Table IV, right, after being heated to 250 to 300° F. for 20 to 30 minutes.

g) Be capable of being flattened to 60% of its original outside diameter without cracking.

The above are specification requirements and are subject to revision. The qualification tests are performed at the Material Laboratory, New York Naval Shipyard.

Fittings

Socket-type fittings were purchased on a proprietary basis for the original installations. At present, there are at least five molders who are tooling up to supply the high impact grade PVC fittings. With the cooperation of industry, specification requirements are being developed and a procurement specification will be prepared which will permit competitive purchase of these fittings. The test program at the Material Laboratory has been necessarily limited by the urgent nature of the procurement program and has been hampered by the unavailability of fittings since it has taken the industry time to modify molds and to tool up to produce fittings of the dimensions and tolerances required. Dimensions and tolerances for the sockets which permit the making up of consistently good pipe joints had to be determined. It was found that up to the 1½-in. pipe size, a maximum diametrical clearance of 40 mils down to an interference of 10 mils between the pipe and base of the socket could be tolerated.

For pipe sizes 2 in. and larger, however, it was found that a 10-mil interference would prevent the pipe from bottoming in the socket and a poor joint would result. Diametrical clearance for sizes of 2 in. and above, therefore, was set at 40 mils maximum, 0 minimum. Socket dimensions and tolerances are indicated in Table V, below. Hydrostatic burst pressure and drop-ball impact requirements will also be specified. Types of fittings which will be required vary in size from ¾ to 3 in. inclusive, and the types include 45° and 90° ells, tees, reducing bushings, straight couplings, and screw thread adapters for connecting to bronze spray nozzles and also to adapt to aluminum piping in certain areas.

Table IV: Bending requirements

Pipe size	*Diameter of form*
I.p.s.	*in.*
¾	5.5
1	6.5
1¼	8.5
1½	9.5
2	12.0
2½	14.5
3	17.5

To expedite installation of the washdown systems, detailed instructions and plans have been prepared so that the piping may be installed by the ships' force.

Conclusion

Although plastics have been finding ever increasing usage on board naval vessels for at least 30 years, progress has been principally in electrical applications. The proposed installation of plastic washdown systems represents one of the most important advances made by the plastics industry in the non-electrical field. There are many other important potential shipboard applications which should open up as the Navy becomes more familiar with the advantages as well as limitations of plastics piping. Some of the immediately foreseeable ones include submarine battery cooling-water systems where the corrosion resistance of plastics pipe makes it an obvious choice; minesweeper applications where its non-magnetic characteristics make it a desirable replacement for critical metal alloys; and in low-pressure sump drainage systems as well as the electrical conduit used in such systems.

Table V: Socket dimensions and tolerences for pipe fittings

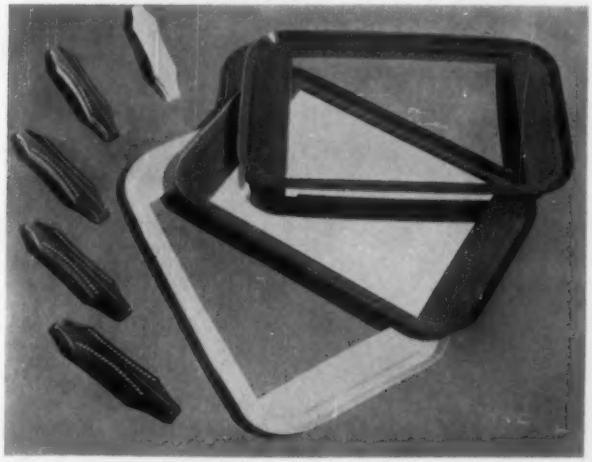
Size	*Diameter at entrance of socket (in.)*		*Diameter at bottom of socket (in.)*	*Depth of socket (in.)*
I.p.s.	*Maximum*	*Minimum*	*Minimum*	*± 1/64*
¾	1.075	1.055	1.045	1
1	1.340	1.320	1.310	1⅛
1¼	1.685	1.665	1.655	1¼
1½	1.920	1.905	1.895	1⅜
2	2.395	2.380	2.380	1½



Frame for mirror is molded of polyethylene; tray, tray lid, and handles are molded of impact polystyrene. (Photo Koppers Co., Inc.)

Up-grading luggage

Travel case manufacturers have turned to molded polyethylene and polystyrene components to improve the quality and reduce the cost of their products



Polyethylene mirror frames and handles. Intaglio stitch-like marks on handles are hot-stamped. (Photo, Eastman Chemical Products)

The luggage field continues to offer ever new market opportunities for plastics. Latest cases in point involve Reliable Luggage, Inc., West Pittsburgh, Pa., and Trojan Luggage Co., Memphis, Tenn., pioneers in the use of plastics in luggage, who have incorporated several molded styrene and polyethylene components in a number of their travel case lines. These molded parts include handles, mirror frames, and trays.

Scuff-resistant molded handles

To replace more expensive and less scuff-resistant leather handles, Reliable chose both polyethylene and high impact styrene molded handles, the former for its more expensive pieces. Trojan adopted impact styrene. These new handles, in addition to being less costly and tougher, also offer greater flexibility in color and design and stand up extremely well in use.

Both types of handles are molded on 12-oz. injection machines in multi-cavity molds. They are produced in a variety of integral colors to match the shades of the cases to which they are attached. In the styrene handles, a hole is drilled at each end to accommodate mounting posts; slots for mounting posts are molded into the polyethylene handles.

Most models of the styrene handles have molded-in decorative designs. In several instances, these designs also serve the additional purpose of giving the handle a functional shape to facilitate carrying. The polyethylene handles incorporate an intaglio design that suggests machine stitching. This design is hot-stamped into the handle after it has been molded.

(*To page* 264)

First sun-powered radio

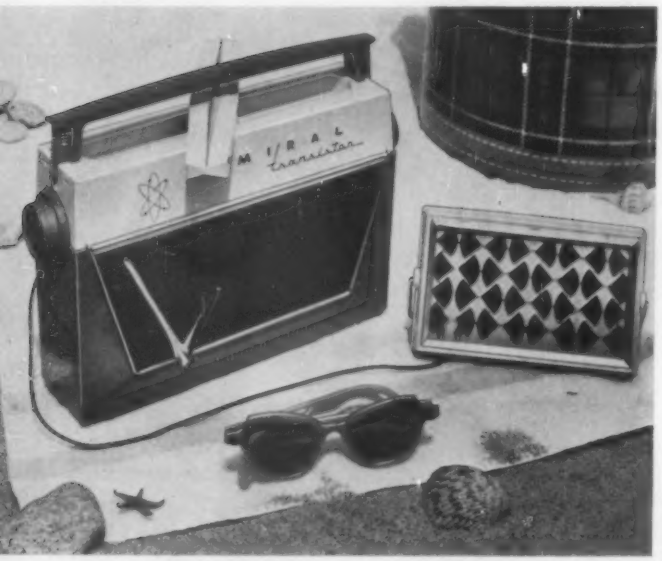
has 14 plastics parts in set and power source

More plastic components than meet the eye at first glance contribute to the operation of Admiral Corp's. new sun-powered tubeless portable radio. High-impact styrene, acrylic, and phenolic laminate go into 14 major parts of this set and its accessory Sun Power Pak.

Described as the world's first radio of its type, the new Admiral unit contains six tiny transistors which, in addition to keeping the set compact in size and light in weight (5¼ lb.), require only one-tenth the power of ordinary tubes. Thus the set will operate for 700 to 1000 hours on six "D" size flashlight cells costing less than $1, or directly from the Sun Power Pak.

The toughness of the high-impact styrene case enables Admiral to offer a five year guarantee on the case and to advertise it as unbreakable. Within the set itself, plastics make another major contribution as the phenolic-laminate base of the printed circuit chassis.

The Admiral Sun Power Pak, which is sold as an optional accessory to the set at $185, depends for its operation upon silicon cells such as those recently incorporated in an experi-



Sun Power Pak, of 32 silicon cells (right center), converts sun's rays to electricity to operate radio. (Photos, Catalin Corp.)



Compact, easy-to-carry portable radio, complete with Sun Power Pak, also operates on six ordinary flashlight batteries

mental rural telephone installation in Georgia.[1] The Sun Power Pak is composed almost entirely of molded and fabricated sheet acrylic and is enclosed in a molded high impact styrene housing. Within the molded housing, the silicon cells are combined with an electrolytic capacitor which stabilizes the voltage produced by the cells, thus preventing the volume of the radio from diminishing when the cells are shaded from the sun's rays.

National Fabricated Products, Div. of Hoffman Electronics Corp., Chicago, Ill., produces the silicon cells, while Ajax Condenser Co., Chicago, makes the electrolytic capacitor. Final assembly of the Sun Power Pak is done by Admiral, which also molds the parts for the sun pak enclosure, as well as all components of the portable radio case, at its Molded Products plant in West Chicago, Ill.

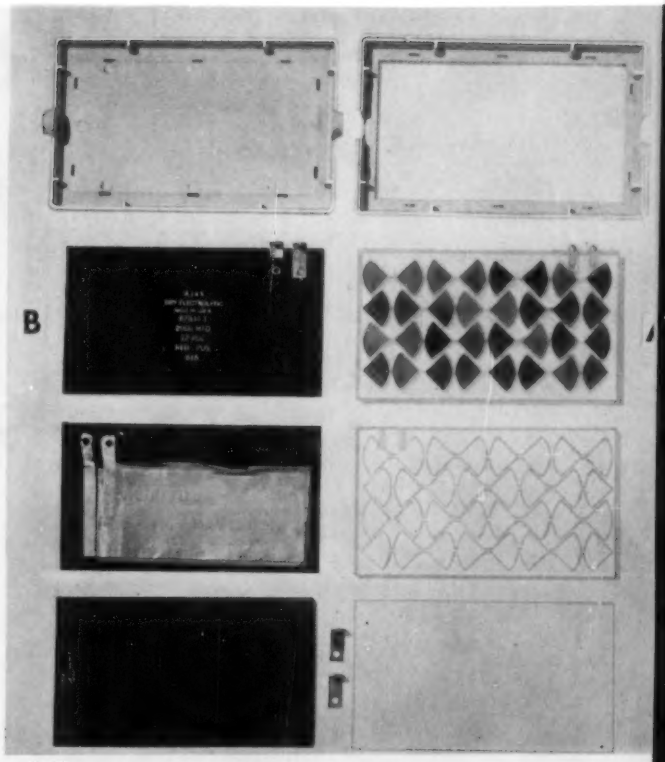
Two clear transparent acrylic parts—one injection molded, the other a rectangular piece of 1/16 in. sheet stock—are used in the silicon cell assembly. The silicon cells are held in form-fitting cavities in the back surface of the injection molded component; an adhesive is applied around the edges of the molded part and the flat sheet of clear acrylic is placed over it, sealing the cells into a permanent housing.

The capacitor, made by Ajax Condenser Co., consists of an assembly produced by stacking plates made of high quality aluminum foil separated by absorbent paper sheets which are impregnated in an electrolytic solution after assembly. This assembly is then sealed between two sheets of 1/16-in. black acrylic.

The extensive use of plastics materials in Admiral's new Sun Power Pak may presage the development of an important new type of outlet for plastics in the electronics field. With the rapid improvement of "sun-powered" silicon cells, which require housings combining physical protection with optical clarity for maximum light transmission, industry today stands on the threshold of many important new advancements in this field.

Credits: Extra-high-impact styrene for radio case and Power Pak housing, Catalin Corp. of America, New York, N.Y. Molding of acrylic part for silicon cell unit, Korris Products, Inc., Lyons, Ill., using Du Pont Lucite. Plexiglas sheet for Sun Power Pak components, Rohm & Haas Co. Paper-base phenolic laminate for printed circuit boards, The Formica Co., Cincinnati, Ohio; Mica Insulator Co., Schenectady, N.Y.; and Synthane Corporation, Oaks, Pa.

[1] See MODERN PLASTICS 33, 104 (Feb. 1956).



Parts of Sun Power Pak made of plastics: outer housing (two top pieces) injection molded of impact styrene; silicon cell assembly (A) sealed between molded acrylic plate and 1/16-in. acrylic sheet; electrolytic capacitor (B) consists of aluminum foil and paper sheets between two sheets of black acrylic

Plastics components of radio (top to bottom): cabinet top and bottom, two-piece housing for rotating antenna, control knobs, and carrying handle—all injection molded of extra-high-impact styrene; printed circuit base (bottom) is paper-phenolic laminate.





Carton containing precooked food in heat-sealed polyester-polyethylene laminate bag is stored in refrigerator until used

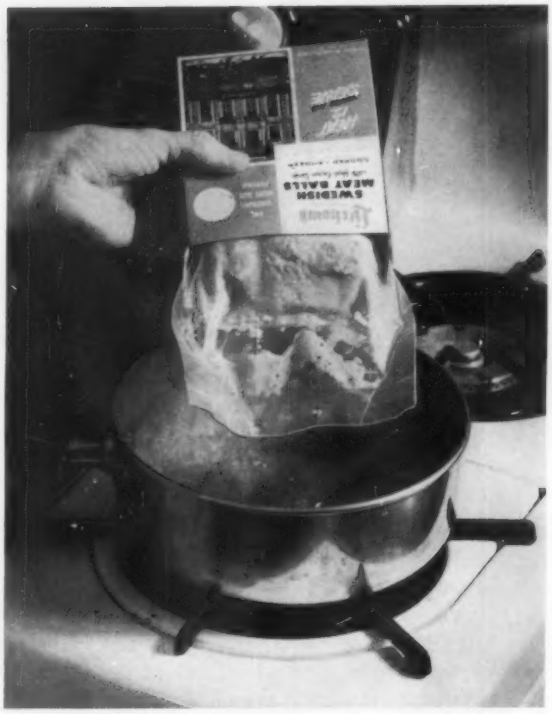
Boiled in film

Frozen or fresh food products that can be cooked or heated without being removed from their Mylar polyester film wrappings represent the latest wrinkle in convenience packaging for the housewife.

Since the film is strong, transparent, and unaffected by extreme cold or heat (from −80 to +300° F.), it offers the food industry the ideal characteristics for the "heat-in-the-bag" type of merchandising which is expected to revolutionize the marketing of frozen foods—particularly frozen precooked meat dishes. Along these lines, Luchow's, the famed New York restaurant, recently made a significant step forward by introducing a group of its meat specialties (beef goulash, Salisbury steak, meatballs, etc.) precooked according to Luchow recipes and frozen in a heat-sealed boilable pouch fabricated from a polyester-polyethylene film combination. The ½-mil Mylar film (on the outside of the pouch) and the 1½-mil polyethylene film (used on the inside for its heat sealable characteristics) are laminated together with a special adhesive strong enough to endure the freezing and heating cycles to which the package is subjected.

To prepare the food, the housewife simply removes the plastic bag and its contents from the cardboard carton in which it is packed and drops it into boiling water. After approximately 12 min., the pouch is lifted out of the pot by snagging one of the eyelets in the top of the film bag. The bag is then cut open and the contents emptied into plate or bowl—piping hot, ready to eat, and offering the same quality and flavor that made the dishes so popular on the menu at Luchow's.

Until ready to serve, the pouches can be stored in the refrigerator, no defrosting is necessary, and best of all, from the standpoint of the housewife, since the food remains in the bag throughout the cooking operations, there are no messy pots or pans to clean.



To prepare food, transparent plastic bag is simply removed from carton and placed in pot of boiling water. Defrosting of contents is unnecessary

Luchow's is currently turning the packages out at the rate of 30,000 a day for distribution through 1000 food stores in the New York City area—ranging from Macy's department store to neighborhood delicatessens. So enthusiastic has been the reception to the idea, however, that plans are currently underway for increased production and nation-wide distribution.

Large-volume possibilities

More important, the success of the Luchow offering has stimulated interest in flexible plastics film packaging on the part of other sup-

Precooked meat dishes are frozen in polyester film bag; food is prepared for serving by placing unopened bag in boiling water for 12 minutes



After 12 min., pouch is removed from water by snagging eyelet with fork. Since food remains in bag when cooking, there are no messy utensils to clean



Plastic bag is then cut open and contents emptied into plate or bowl—piping hot and ready to eat. (Photos, E. I. du Pont de Nemours & Co., Inc.)

pliers of food products. A number of other famous restaurants are expected to follow Luchow's lead; some have already indicated their desire to enter the field. It is also possible that the idea can be adapted to 25- or 50-lb. sacks (containing frozen precooked meats) which would simplify cooking operations in dining cars, airlines, institutions, and industrial cafeterias.

Precooked meats have already jumped to 4th place in consumer sales of frozen foods—and the rise is still continuing. Some packagers visualize the day when even greater impetus will be given to the sale of precooked meats by applying irradiation to the foods to lengthen their storage life (with or without refrigeration) far beyond that possible today. And there is talk in the industry of marketing a complete precooked meal, including meat, vegetable, potatoes, etc., in a single boilable plastic pouch. Since each item would be stored in its individual heat-sealed compartment, the entire meal could be prepared for the table at the same time.

In other areas of the food field, the Mylar-polyethylene film lamination holds considerable potential for the packaging of such items as frozen fish and frozen (and fresh) farm produce that can be cooked right in the bag. Corn, for example, could be husked at the farm (reducing weight and thereby lowering shipping costs), cooked, placed in the plastic bag, and then blanched and frozen. At meal time, the bag need simply be dumped into boiling water for a short time to prepare the corn for eating. Similar packaging techniques could be applied to the merchandising of uncooked fresh corn, squash, and other food products.

Credits: Film pouch for Luchow's packages developed and supplied by Standard Packaging Corp., Flex-Vac Div., New York, N. Y., and the Dobeckmun Co., Cleveland, Ohio. Mylar polyester film supplied by E. I. du Pont de Nemours & Co., Inc.



GERMANY: phenomenal resurgence

*By Dr. Ing. Benedikt Rau**

Until the end of World War II, Germany and the U.S.A. were the leading plastics producing countries in the world, followed only at a great distance by other industrial countries.

As a result of the war and its economic consequences, Germany lost its position as a large producer of plastics. Among these consequences was the partitioning of Germany which dissolved the important connections that formerly held together a closely knit economic body. Production equipment for important polymerization plastics as well as that for condensation products had to be again acquired in West Germany, and the obtaining of raw materials for the entire plastics field had to be assured, at least in part, through new channels.

Germany's peak production year in the field of plastics was 1944, with a quantity of 250,000 tons; German plastics production in 1947 was 23,000 tons (no figures were published for 1945 and 1946), or less than one-tenth of the 1944 peak. [In this article, volume is given in metric tons (2204.6 lb.) as is common in German plastics industry reporting. *Ed.*] Germany, which formerly could be called a plastics export country, was even forced during the first few years after the war to import considerable quantities of plastics. German plastics production in 1936 and from 1950 through 1955 is shown in Table I, p. 139.

From these figures it can be seen that the German plastics industry within 5 years after 1947 was able to increase its production to 190,000 tons and thus once again assume second place among the producing countries. West Germany, to be sure, is far behind the U.S.A. today; even if the production of the Soviet Zone of Occupation is included, which is estimated by us at 100,000 tons per year, plastics production in the U.S.A. triples that of Germany.

The importance of plastics producing industry today, within the framework of the German chemical industry, is evidenced by the fact that plastics production in 1955 had a 9% share in the total chemicals turnover.

About 60 companies (see Table II, p. 140) of varying sizes shared in the 1955 German plastics production of 425,000 tons. A study which was carried out for the year 1954 showed that 50% of the production comes from only five companies and 25% from an additional nine companies, with the remaining 25% distributed over 46 companies.

German plastics production covers all plas-

Presented here is the ninth article in the series "Wide World of Plastics" which started in our May issue.

These authoritative articles are written by plastics publication editors or industry leaders. The purpose of the series is to show the progress of plastics throughout the world.

In each succeeding issue, countries not checked in the list at the right will be represented.

Argentina ✓
Australia ✓
Belgium ✓
Brazil
Canada
Denmark
France ✓
Germany (West) ✓
Great Britain ✓
Holland ✓
India
Israel ✓
Italy ✓
Japan ✓
Luxemburg ✓
Mexico
New Zealand
Norway
South Africa
Spain
Sweden
Turkey

✓ Covered in this issue
✓ In previous issues

*Assistant Manager, Association of the Plastics Producing Industries and Related Fields.



Section of a German railroad passenger car produced with sandwich constructions having rigid polyurethane cores. (Photo, Farbenfabriken Bayer, Leverkusen)



Housecoat lined with Moltopren, a synthetic foam based on polyurethane. (Photo, Farbenfabriken Bayer)

tics which have achieved practical importance. Bottlenecks which continued until recently in the obtaining of sufficient domestic quantities of polyvinyl chloride, polyethylene, and special grades of polystyrene have been eliminated by large scale expansions.

With the rebuilding of the German plastics industry, which was accelerated after 1950, Germany succeeded also in increasing its exports of plastics. Even though such expansion could largely be based on old, well-proved business connections, it nevertheless took years until it was possible to recreate the prerequisites for satisfactory exports.

German imports and exports of plastics materials are reported, in pounds, in Table III, p. 142. In 1955, 87,000 tons of plastics with a value of 297 million German marks were exported; i.e., 20% of the total quantity of the production and 25% of the total value of the production. About 70% of these exports went to European countries and 30% overseas. Some 2780 tons with a value of 10.7 million German marks were delivered to the U.S.A.

Imports in 1955 totalled 21,300 tons, with a value of 67 million German marks. This included 6300 tons, with a value of 22 million German marks, from the U.S.A. alone, from which country came polyethylene, modified natural resins, cellophane, alkyd resins, special grades of polystyrene and vulcanized fibre, as well as ethyl cellulose which is not produced in Germany.

The largest share in the total production is enjoyed by the polymerization resins, followed at a short distance by condensation products and at a great distance by cellulose derivatives.

Polyvinyl chloride

Polyvinyl chloride, with a total of 65,000 tons produced in six different plants, stands at the peak. In addition to emulsion polymers, sus-

Table I: German plastics production

(In metric tons: 2204.6 lb.)

	1936	1950	1951	1952	1953	1954	1955
Cellulose derivatives	31	28	31	29	39	47	50
Condensation products	44	40	81	80	97	130	175
Polymerization products	2	30	56	81	104	148	200
Total	77	98	168	190	240	325	425

Table II: German Plastics Manufacturers

PHENOLICS: TECHNICAL RESINS, MOLDING COMPOSITIONS

Bakelite Gesellschaft m.b.H.
Letmathe

Bisterfeld & Stolting
Neuenherweg üb.Wipperfürth

Chemische Werke Albert
Wiesbaden-Biebrich

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

Gesellschaft für Teerverwertung m.b.H.
Duisburg-Meiderich

Internationale Galalithgesellschaft A.G.
Hamburg-Harburg

New-York Hamburger Gummi-Waaren Compagnie
Hamburg-Harburg

Dr. F. Raschig G.m.b.H.
Ludwigshafen/Rhein

Reichhold-Chemie A.G.
Hamburg-Wandsbek

Resart-Gesellschaft Kalkhof & Rose
Mainz/Rhein

Süd-West-Chemie G.m.b.H.
Neu-Ulm/Donau, Am Pfaffenweg

Südwestdeutsches Kunstharz-Werk
Dr. Elbel G.m.b.H.
Frankfurt a.M.

PHENOLICS: COATING RESINS

Allegemeine Elektricitaets-Gesellschaft
Frankfurt a.M.

Bisterfeld & Stolting
Neuenherweg/üb. Wipperfürth

Robert Bosch G.m.b.H.
Stuttgart

Dielektra Aktiengesellschaft
Porz/Rhein

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

Elektro-Isolier-Industrie Wahn
Wilhelm Ruppert
Wahn/Rhld.

Ferrozell-Gesellschaft Sachs & Co.
Augsburg

Isola-Werke A.G.
Düren-Rhld.-Birkesdorf

H. Roemmler G.m.b.H.
Gross-Umstadt

Siemens-Schuckert-Werke A.G.
Erlangen

[1]Primary producer

Wrede & Strahlau
Hannover-Linden

AMINOS

Badische Anilin-und Sodafabrik A.G.
Ludwigshafen/Rhein

Bakelite Gesellschaft m.b.H.
Letmathe

Bisterfeld & Stolting
Neuenherweg/üb. Wipperfürth

Cassella Farbwerke Mainkur A.G.
Frankfurt a.M.-Fechenheim

Chemische Werke Albert
Wiesbaden-Biebrich

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

Henkel & Cie. G.m.b.H.
Düsseldorf-Holthausen

Internationale Galalithgesellschaft A.G.
Hamburg-Harburg

New-York Hamburger Gummi-Waaren Compagnie
Hamburg-Harburg

Reichhold-Chemie A.G.
Hamburg-Wandsbek

H. Roemmler G.m.b.H.
Gross-Umstadt

Süddeutsche Kalkstickstoff-Werke A.G.
Trostberg/Obb.

Süd-West-Chemie G.m.b.H.
Neu-Ulm/Donau

POLYESTERS

Badische Anilin-und Sodafabrik A.G.
Ludwigshafen/Rhein

Chemische Werke Hüls A.G.
Marl/Krs. Recklinghausen

Farbenfabriken Bayer A.G.
Leverkusen

Dr. Kurt Herberts & Co.
Wuppertal-Barmen

Reichhold-Chemie A.G.
Hamburg-Wandsbek

POLYAMIDES

Badische Anilin-und Sodafabrik A.G.
Ludwigshafen/Rhein

Chemische Werke Hüls A.G.
Marl/Krs. Recklinghausen

Farbenfabriken Bayer A.G.
Leverkusen

POLYURETHANES

Farbenfabriken Bayer A.G.
Leverkusen

SILICONES

Farbenfabriken Bayer A.G.
Leverkusen

Th. Goldschmidt A.G.
Essen

Wacker-Chemie G.m.b.H.
München

ALKYDS

Anorgana G.m.b.H. München
Gendorf/Obb.

Chemische Werke Albert
Wiesbaden-Biebrich

Farbenfabriken Bayer A.G.
Leverkusen

Reichhold-Chemie A.G.
Hamburg-Wandsbek

Sichel-Werke A.G.
Hannover-Limmer

CELLULOSE ACETATE

Farbenfabriken Bayer A.G.[1]
Leverkusen

Wacker-Chemie G.m.b.H.[1]
München

Lonza-Werke G.m.b.H.[1]
Weil/Rhein

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

A. Hagedorn & Co. A.G.
Osnabrück

Celluloidfabrik Speyer
Franz Kirrmeier G.m.b.H.
Speyer/Rhein

Rheinische Gummi-und Celluloid-Fabrik
Mannheim-Neckarau

CELLULOSE NITRATE AND CELLULOID

Dynamit Actien-Gesellschaft[1]
Troisdorf/Bez. Koeln

Celluloidfabrik Speyer[1]
Franz Kirrmeier G.m.b.H.
Speyer/Rhein

A. Hagedorn & Co. A.G.[1]
Osnabrück

Wasag-Chemie A.G.[1]
Essen

Wolff & Co. K.G.a.A.[1]
Walsrode/Hann.

Rheinische Gummi-und Celluloid-Fabrik
Mannheim-Neckarau

Westdeutsche Celluloidwerke G.m.b.H.
Lank/Ndrh.

Aug. Elhardt Soehne K.G.
Durach/Allg.

Hannoversche Kunsthorn K.G.
Busche & Co.
Hannover-Hainholz

Idealith-Werk, Josef M. Bolkart
Nürnberg

Internationale Galalithgesellschaft A.G.
Hamburg-Harburg

"Wehalith" Heinrich Wenigmann
Haan/Rhld.

Albert Wendt A.G.
Ergolding/Nb.

VULCANIZED FIBRE

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

Vulkanfiberfabrik Grashorn & Co.
Wildeshausen

Vulkanfiber-Fabrik
Ernst Krüger & Co. K.G.
Geldern/Rhld.

CELLOPHANE

Kalle & Co. A.G.
Wiesbaden-Biebrich

Phrix-Werke A.G.
Hamburg

Wolff & Co. K.G.a.A.
Walsrode/Hann.

J. P. Bemberg A.G.
Wuppertal-Barmen

CELLULOSE ETHER

Kalle & Co. A.G.
Wiesbaden-Biebrich

Wolff & Co. K.G.a.A.
Walsrode/Hann.

Henkel & Cie G.m.b.H.
Düsseldorf-Holthausen

Sichel-Werke A.G.
Hannover-Limmer

POLYVINYL CHLORIDE

Anorgana G.m.b.H. München
Gendorf/Obb.

Badische Anilin-und Sodafabrik A.G.
Ludwigshafen/Rhein

Chemische Werke Hüls A.G.
Marl/Krs. Recklinghausen

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

Farbwerke Hoechst A.G.
Frankfurt a.M.-Hoechst

Wacker-Chemie G.m.b.H.
München

POLYSTYRENE

Badische Anilin-und Sodafabrik A.G.[1]
Ludwigshafen/Rhein

Chemische Werke Hüls A.G.[1]
Marl/Krs. Recklinghausen

Dynamit Actien-Gesellschaft
Troisdorf/Bez. Koeln

Hagedorn & Co. A.G.
Osnabrück

Rheinische Gummi- und Celluloid-Fabrik
Mannheim-Neckarau

POLYVINYL ACETATE, POLYVINYL ACETALS, POLYVINYL ALCOHOL

Farbwerke Hoechst A.G.
Frankfurt a.M.-Hoechst

Wacker-Chemie G.m.b.H.
München

POLYETHYLENE

Badische Anilin-und Sodafabrik A.G.
Ludwigshafen/Rhein

Farbwerke Hoechst A.G.
Frankfurt a.M.-Hoechst

Rheinische Olefinwerke
Wesseling

POLYACRYLATES AND POLYMETHACRYLATES

Badische Anilin-und Sodafabrik A.G.
Ludwigshafen/Rhein

Resart Gesellschaft
Kalkhof & Rose
Mainz/Rhein

Rohm & Haas G.m.b.H.
Darmstadt

FLUOROCARBONS

Farbwerke Hoechst A.G.
Frankfurt a.M.-Hoechst

pension polymers are also being produced to an increasing extent. Germany's own production was not sufficient for many years to satisfy the total domestic demand. Imports, particularly from Italy and Yugoslavia, had to make up the deficit. By considerable expansion, it has been possible in the meantime to adapt capacity to increasing requirements. It is expected that within the year a capacity of almost 100,000 tons will be available.

Of the 60,000 tons of polyvinyl chloride consumed domestically in 1955, slightly less than one-half was used for film, artificial leather, and floor coverings, 25% for cable insulation, 15% for tubes, profiles, and extrusions, and another 10% as hard PVC, particularly for chemical apparatus as well as the production of pipes.

All these fields are in the course of further extensive expansion.



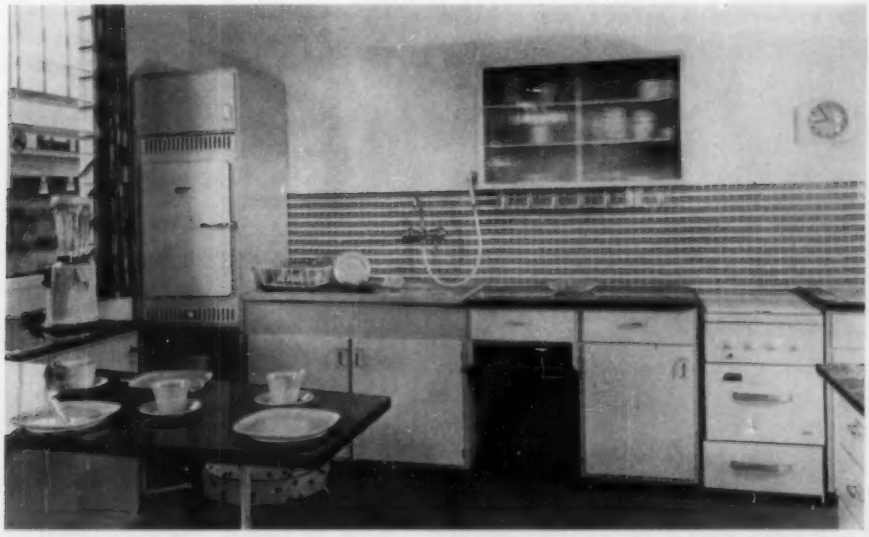
Flexible Guttagena Glasklar PVC film finds agricultural applications. (Photo, Anorgana GmbH, Genndorf, Obb.)

Polyvinyl acetate, alcohol, and acetals

Another important group of plastics is that consisting of polyvinyl acetate and its products. Since there are only two German producers, no production figures are published. The main fields of use for polyvinyl acetate, in sequence of their importance, are paints, glues and binders, surface finishes, and textile treatments.

Polyvinyl alcohol has recently come into use as film for the packing of pest-control agents and as a covering for molds in the processing of reinforced polyesters.

Of the polyvinyl acetals, polyvinyl butyral is used in the lacquer and varnish industry as metal primers and in safety glass as the interlayer; formaldehyde is used in combination with other resins for wire insulation and recently to produce sponges which have particu-



Modern kitchen display exhibited at recent Duesseldorf Fair to show the extent of plastics usage as well as the up-grading in colors and over-all design

Table III: German production, import, and export of plastics, 1955

	(in 1000 lb.)		
	Production	Import	Export
Polyacrylates and methylacrylates	24,600	500	12,300
Cellulose derivatives	111,000	5,900	24,800
Polyethylene, polyisobutylene and fluorocarbons	14,300	6,400	1,500
Polyamides, polyurethanes, polyesters	33,200	500	3,900
Polystyrene	48,500	3,300	14,100
Vinyls	327,000	18,300	89,000
Aminos (melamine and urea)	121,500	3,300	6,700
Phenolics (molding materials, coating plastics, technical resins)	170,200	1,100	18,200
Epoxides		1,300	—
Alkyds and other condensation and polymerization products not mentioned above	84,700	6,200	21,600
Total	935,000	46,800	192,100

larly high water absorptivity. No extensive expansion of production of these materials is expected in the immediate future.

Polystyrene

Polystyrene today still constitutes more than 90% of the injection molding materials used in the production of household articles and industrial parts. In addition, high-impact-strength types have been developed which improve the quality of the products made therefrom and make possible new applications on a broad and expanding basis.

Tensile strength test on Vulkollan, a synthetic elastomer based on cross-linked polyurethane. (Photo, Farbenfabriken Bayer)



Polystyrene production in 1955 was more than 20,000 tons. It is expected that this year it will reach 25,000 tons and will increase during the next two years to 30,000 tons.

Exceptional strength is possessed by a copolymer of styrene, acrylonitrile, and butadiene, developed in Germany, which can be processed on ordinary machines. The plastic has extremely high mechanical strength and is particularly well suited for applications such as high-pressure pipes and large structural parts.

Polystyrene foams are enjoying increasing attention both for acoustic and heat insulation; they are also being increasingly used for sandwich constructions.

Polyethylene

The most important recent development has been the low-pressure process for the production of polyethylene (Ziegler process). Higher strength and thermal stability as a result of a different molecular structure give reason to expect that Ziegler polyethylene will, along with high-pressure polyethylene, achieve great importance in the future. At the present time polyethylene is produced in Germany only by three companies. Today production is still low —about 4000 tons in 1955. A large plant is now in operation and it is possible that, starting in the Fall of this year, domestic production will meet domestic demand. In 1956, an annual production rate of approximately 15,000 to 20,000 tons is expected.

In addition to the use of polyethylene in sheet, hollow articles, and molded and extruded products, pipe manufacture is gaining in economic importance. The material has been employed up to the present time to the extent of 33% each for films and injection molding, 15% for pipe, 12% for bottles, 3 to 4% each for cables and various other uses.

Polyacrylates and methacrylates

Some 11,200 tons of polyacrylates and methacrylates were produced in 1955. The production of polymethacrylate plastics, which in 1955 amounted to 5000 to 6000 tons, has again reached considerable volume. Present expansion will multiply the production during the next two years. Developmental work in this field has resulted in an improved adaptability to the needs of end-users, particularly for construction purposes and in the advertising and illuminating arts. Previously unknown lighting effects can be obtained by certain dyes. High-

impact grades are attaining increasing importance for application in explosion-proof protective devices.

Cellulose derivatives

In contradistinction to the statistics of some other countries, cellophane, vulcanized fibre, and cellulose ether, in addition to cellulose esters, are included among plastics production in Germany. In 1955, 12,800 tons of nitrocellulose and 13,800 tons of acetyl cellulose were manufactured. Nitrocellulose is used primarily for surface coatings and secondarily for Celluloid. Of the latter, 3900 tons were produced. The cellulose-acetate production breaks down into 3500 tons for injection moldings and about 4000 tons for film bases and foils, the balance being processed largely into chemical fibers. Cellophane production was about 16,000 tons and vulcanized fibre about 2000 tons.

Phenolics

The most important group of condensation products is still the phenolics. Production in 1955 was as follows:

Technical resins, including glue resins	32,000 tons
Molding compounds	33,500 tons
Molded laminates of all types	12,000 tons

Aminos

While in the case of the phenolics, molding compounds and technical resins approximately balance each other, the supremacy in the aminos is clearly enjoyed by the technical resins and particularly by the adhesive resins:

Adhesive and other resins	49,500 tons
Molding compositions	5,700 tons

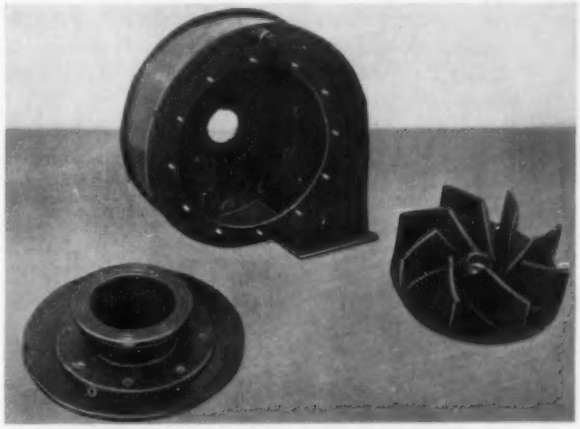
Despite their substantially higher price, the melamine resins, in view of their more favorable mechanical and electrical properties, are meeting with favor, particularly for molding.

Polyesters and polyamides

Polyesters have been produced in Germany for several years. In the unsaturated polyester resins, emphasis is on large objects in the field of building—panels for roofs and glazing, and bathtubs and sinks. The polyesters are also used in containers of all kinds and, as a special field, in boat construction. Mass production of automobile bodies still requires extensive developmental work.

About 1500 tons of unsaturated polyester resins were produced in 1955; 4000 tons can be expected in 1956. In addition to the polyesters, which are produced in considerable extent for polyurethane plastics, reference should also be made to the polyterephthalic acid esters which are being used in Germany not only for synthetic fibers but also for the production of sheets having exceptionally high mechanical strength.

Polyamides are made both from caprolactam and from adipic acid/hexamethylene diamine. Production in 1955 was about 2000 tons, plus some 10,000 tons which were fabricated into synthetic fibers. Of the material sold in the form of compounds, about 1800 tons were used in injection molding, and the (*To page* 278)



Exhaust fan and housing made of Hostalen low-pressure polyethylene has capacity of about 27,000 cu. ft./hr. (Photo, Hoechst)



Desk is surfaced with Trolonit and Ultrapas decorative laminates. (Photo, Dynamit)

Analysis of plasticizer production in 1955

By Howard I. Armstrong, Peter W. Spink†, and Walter F. Waychoff†*

The year 1955 was a major growth year for the plastics industry. From the standpoint of plasticizers it was a period characterized more by development of established products than by the introduction of new materials. Specifically, there was the further expansion of phthalate esters as the principal plasticizers for polyvinyl chloride; in addition, the other major types all expanded in usage. Few, if any, new types were adopted commercially.

Up 95 million lb.

The U. S. Tariff Commission in its preliminary annual report listed plasticizer production in 1955 as 396 million lb. as compared with 301 million lb. in 1954. This is a healthy gain of 95 million lb. in 1955—the banner year to date.

Of this amount approximately 175 million lb. of plasticizer went into vinyl chloride and vinyl chloride copolymers. This represents roughly 45% of the total production. The remaining 221 million lb. includes plasticizers for other vinyls, cellulosics, and miscellaneous resins. In addition, significant quantities were used as gasoline additives, lubricants, functional fluids in Ordnance applications, and in the rubber industry.

Sales for 1955 account for 337 million of the 396 million lb. produced. The surplus of 59 million lb. may be accounted for by captive use and carry-over inventory. This amount represents an approximate two months' inventory, which would not be unusual.

Little change was made during 1955 in the acids used for manufacturing plasticizers. Most of these seem to be firmly established. There was, however, a notable trend toward using some of the newer alcohols now available. This trend is expected to continue into 1956 and subsequent years as plasticizer manufacturers and consumers develop more specific applications to take advantage of the improved properties offered by these newer alcohol-acid combinations.

It must be kept in mind that the Government figures are divided into cyclic and acyclic classifications. Of course, the cyclics contain aromatic and benzene nuclei in their chemical structure. Acyclic products do not contain aromatic groupings; they consist of aliphatic chemicals which are derived from fats, vegetable oils, fermentation products, and natural gas. In the Government's report this year, figures for TCP plasticizers are combined with those for TCP used as a petroleum additive. The "all-other" categories, both cyclic and acyclic, include many plasticizers which are enumerated at the bottom of Table I, opposite.

Cyclic plasticizers

Phthalate esters: The phthalate esters continue their dominance of the plasticizer field, comprising 54% of the total plasticizer production in 1955, or 213 million pounds. Largest single usage of plasticizers was the 130 million lb. of phthalate esters which went into vinyl chloride or vinyl copolymer resins. Among the phthalate plasticizers, the leaders for these applications were di (2-ethylhexyl) phthalate, diisooctyl phthalate, diisodecyl phthalate, dicapryl phthalate, butyl benzyl phthalate, octyl decyl phthalate, and butyl decyl and butyl octyl phthalate.

Di (2-ethylhexyl) phthalate (DOP) had its biggest year in history with a total production of 72 million pounds. DOP is by now so firmly established that it is the so-called standard of the plasticizer industry. Its popularity is well founded upon a good general balance of properties. Its excellent compatibility with vinyl, combined with its price and properties, makes it the most widely accepted product.

Diisooctyl phthalate continued its growth in 1955, but at a somewhat slower rate that 2-ethylhexyl phthalate. This may be due to the

* Manager, Plasticizer Sales Dept., Monsanto Chemical Co.
† Plasticizer Sales Dept., Monsanto Chemical Co.

Table I: Synthetic organic chemicals: United States production and sales of plasticizers*

Material	Production 1952	Production 1953	Production 1954	Production 1955	Sales 1955 Quantity	Sales 1955 Value	Unit value[a]
	1000 lb.	*1000 lb.*	*1000 lb.*	*1000 lb.*	*1000 lb.*	*$1000*	*Per lb.*
GRAND TOTAL	**267,724**	**292,898**	**300,674**	**396,056**	**337,209**	**103,397**	**$0.31**
PLASTICIZERS, CYCLIC							
Total	**194,362**	**223,810**	**227,618**	**296,294**	**252,223**	**71,601**	**.28**
Phosphoric acid esters							
Tricresyl phosphate[b]	18,031	22,109	23,847	34,194	32,027	9,781	.31
Triphenyl phosphate	5,758	7,418	6,426	8,632	—	—	—
Phthalic anhydride esters, **total**	**149,826**	**165,237**	**170,610**	**212,815**	**181,755**	**50,859**	**.28**
Butyl decyl phthalate	—	—	—	1,036	—	—	—
Dibutyl phthalate	17,881	23,280	19,876	23,858	17,728	4,677	.26
Dicapryl phthalate	5,246	7,762	5,832	—	6,290	1,807	.29
Didecyl phthalate	—	—	—	5,069	3,416	996	.29
Diethyl phthalate	12,138	17,584	15,999	15,799	11,087	2,714	.24
Diisodecyl phthalate	—	—	—	3,899	3,127	914	.29
Di(2-methoxyethyl)phthalate	1,576	2,240	2,098	3,005	—	—	—
Dimethyl phthalate	2,901	2,508	2,557	3,950	3,288	846	.26
Dioctyl phthalates, **total**	**86,857**	**84,813**	**88,224**	**102,287**	**87,965**	**23,072**	**.26**
Di(2-ethylhexyl)phthalate	63,236	51,281	54,067	71,640	58,900	14,519	.25
Diisooctyl, di-n-octyl and mixed octyl phthalates	23,621	33,532	34,157	30,647	29,065	8,553	.29
Octyl decyl phthalate	—	8,678	10,060	13,102	12,769	4,083	.32
All others	23,227	18,372	25,964	40,810	36,085	11,750	.33
All other cyclic plasticizers[c]	20,747	29,046	26,735	40,653	38,441	10,961	.29
PLASTICIZERS, ACYCLIC							
Total	**73,362**	**69,088**	**73,056**	**99,762**	**84,986**	**31,796**	**.37**
Adipic acid esters, **total**	**7,277**	**9,177**	**7,037**	**10,592**	**7,933**	**3,289**	**.41**
Didecyl adipate	—	—	—	1,472	839	346	.41
Di(2-ethylhexyl)adipate	3,204	3,497	2,710	2,651	1,860	777	.42
Diisooctyl adipate	1,125	1,511	884	1,592	2,777	933	.34
All others	2,948	4,169	3,443	4,877	2,457	1,230	.50
Glyceryl monoricinoleate	—	—	—	287	75	27	.36
Lauric acid esters[d]	1,085	113	55	—	—	—	—
Oleic acid esters, **total**	**7,223**	**7,952**	**10,095**	**11,545**	**8,594**	**2,738**	**.32**
Butyl oleate	—	1,372	—	1,999	451	97	.22
Methyl oleate	—	—	—	811	—	—	—
All others	—	—	—	8,735	8,143	2,641	.32
Phosphoric acid esters	8,911	8,534	6,122	10,412	7,543	3,274	.43
Ricinoleic acid esters[d]	4,295	4,572	—	—	—	—	—
Sebacic acid esters, **total**	**5,653**	**5,701**	**6,566**	**9,305**	**6,764**	**4,166**	**.62**
Dibutyl sebacate	2,215	2,186	1,950	3,435	1,034	680	.66
All others	3,438	3,515	4,616	5,870	5,730	3,486	.61
Stearic acid esters, **total**	**16,399**	**4,539**	**6,469**	**9,628**	**9,371**	**2,165**	**.23**
Butyl stearate	1,802	2,417	3,647	6,368	6,145	1,268	.21
All others	14,597	2,122	2,822	3,260	3,226	897	.29
Triethylene glycol di(caprylate-caprate)	—	—	—	2,031	2,102	935	.44
All other acyclic plasticizers[e]	22,519	28,500	36,722	45,932	42,604	15,202	.36

* All figures are taken from U. S. Tariff Commission reports. 1955 figures are from preliminary Tariff Comm. report.
[a] Calculated on rounded figures.
[b] Includes material produced for use as motor fuel additive.
[c] Includes data for synthetic camphor, certain phosphoric acid esters, toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers.
[d] Tariff Commission through 1954 listed these separately. In 1955 they were included in "All other acyclic plasticizers."
[e] Includes data for citric and acetylcitric, azelaic, palmitic, tartaric and ricinoleic acid esters, and for butyl myristate glyceryl and glycol esters of certain fatty acids, glyceryl tripropionate, complex polymeric materials, and other acyclic plasticizers.

increased use of diisodecyl phthalate and also to much of its production being included in the dioctyl phthalate figures.

The rise of diisodecyl phthalate in 1955 is very interesting and would seem to forecast a trend. While the Tariff Commission reports didecyl and diisodecyl phthalate separately, these two would seem to belong together since isodecanols are the only decanols available in this price range. The sole commercial source for decyl alcohols is petroleum. A major market for diisodecyl phthalate is the electrical industry where it offers low volatility and electrical properties comparable to DOP. It is widely used for 80° wire and has been used in 90° formulations. Undoubtedly the increased use of DIDP in vinyl insulation has been primarily at the expense of such plasticizers as TCP, DOP, and some polymerics. Diisodecyl phthalate also has attractive volatility for film use, low plastisol viscosity in dispersions, and outstanding resistance to water and to soapy water extraction. For these reasons it is also finding a market in boilable films and plastisol coatings.

Octyl decyl phthalate has shown good growth in 1955. This is primarily due to its lower volatility and improved viscosity characteristics in plastisols when compared to DOP. Its major markets are in electrical insulation, film, and plastisols.

Di (*n*-octyl, *n*-decyl) phthalate, derived from natural alcohols, did not register significant growth in 1955. There are supply limitations on the alcohol that will restrict its growth.

A rapid increase in butyl octyl and butyl decyl type plasticizers was registered in 1955. Offering a more attractive cost than DOP, with flexibility equivalent, these materials have been used in film, sheeting, extrusion, plastisol, tile, and cellulosic applications. Proprietary and specialty plasticizers, such as dicapryl phthalate, butyl benzyl phthalate, and butyl cyclohexyl phthalate, have also continued their growth. Dicapryl phthalate is used primarily as a replacement for DOP where its price advantage is an important feature. Sales are perhaps limited by the availability of raw materials. Butyl benzyl phthalate is firmly established in applications that require monomeric plasticizer with excellent plasticizing action and resistance to extraction by oils and greases.

Secret blends

Butyl cyclohexyl phthalate, dicyclohexyl phthalate, and diphenyl phthalate find their greatest use in vinyls and cellulosics. In 1955 a tremendous interest developed in blends of phthalates with other phthalates and with other plasticizers. Because of the complexity and secrecy of these blends, it is almost impossible to determine the amounts sold or where they were used.

Non-vinyl plasticizers

In the field of non-vinyl plasticizers, dibutyl phthalate is the largest single product used. A major use is in Ordnance applications as a plasticizer for cellulose nitrate. It is also widely used in nitrocellulose lacquers and polyvinyl acetate adhesives and protective coatings. However, dibutyl phthalate has not shown an increase comparable to other large volume phthalates.

Diethyl phthalate at 16 million lb. still finds its big use as a plasticizer for cellulose acetate (often combined with dimethyl phthalate), although there is renewed interest in polyvinyl acetate due to its low coalescence point. This product is still used in some Ordnance applications, but the use seems to be diminishing because of new technological developments.

Dimethyl phthalate and di (2-methoxy ethyl) phthalate are products which maintained a steady consumption pattern in 1955 but also failed to maintain a percentage growth compared with other plasticizers. Dimethyl phthalate also enjoys some sales as an insect repellent.

Phthalate esters in general provide a versatile base for the plastics industry. Their popularity is well established. The properties of these esters can be controlled through the choice of alcohol used in esterification, thereby making possible the development of plasticizers suitable for a variety of resins. This versatility, coupled with favorable price and availability, have made phthalic anhydride esters the choice of most plasticizer customers.

Phosphoric acid esters: The production of tricresyl phosphate moved to new heights in 1955. This growth, however, is not due to increased use as a plasticizer; rather, it reflects continued acceptance by the petroleum industry of TCP as a gasoline additive. TCP is well established as a flameproof plasticizer in polyvinyl chloride as well as in cellulosics. While it has been a standard in vinyl insulation, it is being replaced to some extent by DIDP. Significant quantities of this material are used as a fire-resistant hydraulic fluid and lubricant.

Triphenyl phosphate is widely used in the cellulose acetate field as a flame-retarding plasticizer in combination wtih (*To page* 286)

Chrome protected by vinyl spray

Automatically applied, protective coating replaces paper, speeds operation, and saves labor

Preparing chromium-plated and polished stainless steel body moldings for shipment to service organizations presents a major problem to automobile manufacturers. To avoid scratching of the surfaces during shipment, Buick, for example, formerly packed each part in a paper tube and sealed the ends by stitching. Paper was not inexpensive and a crew of six persons was needed. Total output ran about 45 pieces per hour per person.

To speed this operation, Buick installed an automatic machine to apply and fuse a vinyl plastic covering to the bright surfaces. This machine proved so successful that it paid for itself in 18 months of use. Output is easily maintained at 600 pieces an hour yet only two men are required, one to feed the parts to the conveyor at one end and one to remove the parts from the conveyor at the other.

Thus, two unskilled men do the coating one third faster than six men could apply and stitch the ends of paper tubes—and material cost is considerably less. Moreover, better protection is provided by the vinyl film, yet it is easily peeled off after breaking one end loose.

Basically, the machine is a very simple conveyor made from continuous lengths of steel cable that run over supporting sheaves.

After leaving the loading station, the parts enter a spray booth and pass under a head supporting four spray nozzles set at different angles. These apply the spray on all upper surfaces as the head is reciprocated transversely to the conveyor but parallel to the length of the pieces. Stroke length is adjusted to suit the pieces being processed and settings of nozzles are such that a film about 0.010 in. thick is applied.

There is considerable overspray but, as the sprays are all aimed downward (though at different angles) the overspray is caught in a tank below and re-used.

After leaving the spray area, parts are conveyed through a horizontal oven in which heat from infra-red lamps evaporates the solvent and fuses the coating.—*Herbert Chase, M.E.*

Body moldings are loaded on conveyor at feed end of spray-coating machine (left). Reciprocating head with four spray guns applies coating as moldings move through spray area (right)







Plastics for missiles

As solid fuel binders, in structural components, in electronic parts, and for bonding, coating, and sealing, a number of resins are contributing to the missile program

*By Alfred J. Zaehringer**

Some 15 years ago, the missile industry in the United States was practically non-existent. During World War II several hundred million dollars were spent on U.S. missile projects but they didn't start to pay off until the end of the war. Continued tensions and the Korean conflict, however, accelerated developments. Today the missile industry has skyrocketed to a billion dollar per year business. In a few years, it will reach $1.5 billion. When the time arrives that manned aircraft are relegated to a secondary place in the defense spectrum, even the sky will be no limit for the missile industry.

Present uses of plastics in missiles are summarized in Table I, opposite page; Table II, p. 151, lists today's missile market.

Structure

Basically, a missile is a self-propelled, unmanned device called on to deliver a payload to a specific point. This may be a moving target (such as an aircraft) or it may be a stationary land target. Missiles are of two types: free flight (ballistic) or guided. Because the missile must be capable of unusually high speeds, it is usually propelled by a reaction or rocket engine. Air-breathing engines such as the turbojet or ramjet are used to a smaller extent.

***About the author**

Engaged in rocket research and development since 1937, Alfred J. Zaehringer has worked on such classified projects as Bomarc, Falcon, and rocket-assisted take-off for aircraft. He is now president of American Rocket Co., an engineering consulting firm engaged in rocket development at Wyandotte, Mich. An associate editor for *Jet Propulsion* and rocket editor for *Ordnance*, Mr. Zaehringer is also a member of the American Chemical Society, American Ordnance Association, and the American Rocket Society.

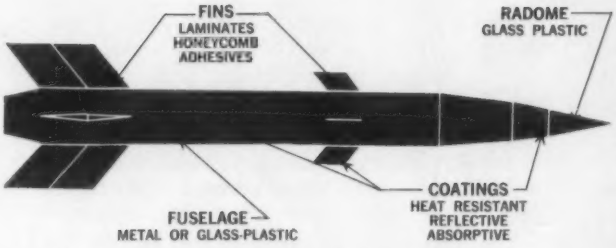


Fig. 1: Generalized outline of a typical rocket missile, showing where plastics materials are being used in its construction

Figure 1, above, shows the basic outline of a typical rocket missile. The rocket engine is located at the rear and fins are provided for control rather than lift. Early rockets used standard aircraft construction (bulkheads, stringers, and stretched metal skin). However, because the rocket engine is such a prodigious user of propellant, every pound saved is more than worth its weight in gold. Therefore, integral construction (in which components are self-supporting) has been adopted. A new approach to the weight problem is the use of glass-reinforced plastics laminates, with which strength/weight ratios superior to metals have been achieved. The high cost of such laminates is usually justified by high missile costs and the need for superior performance and high reliability.

It is now possible to fabricate a complete missile from laminates. Because of their low thermal conductivity, the laminates are particularly advantageous for short-life operation at temperatures above the melting points of metals. The Thompson Fiberglass Co., Los Angeles, Calif., has reported the following performance of laminates:

1) Rocket motor guide vanes with a life of two minutes at over 4500° F.

2) Nose cones on ballistic missiles exposed to temperatures of 750° F. for 30 minutes.

3) Fins on booster rockets good for one minute of operation at 2400° F.

Low-density foams and fillers are also finding extensive use in missiles. And such missiles as the Martin *Matador* (B-61), even though largely constructed of metal, are assembled with plastics adhesives. (Figure 2, above).



Fig. 2: The *Matador*. In assembling this missile, extensive use is made of plastics adhesives. (Photo, The Glenn L. Martin Co.)

Table I: Plastics for missile use

Relative rank	*Est. amt. lb./yr.*	*Use*	*Type*
1	750,000	Fuel-binders for solid and hybrid rockets	Polyethylene Polyester Polysulfide Epoxy Vinyl Polyurethane Synthetic rubber
2	200,000	Laminates, tooling	Polyester Epoxy Phenolic
3	50,000	Electronics	Polyester Epoxy Phenolic Cellulosic Epoxy-polysulfide Epoxy-polyamide Vinyl
		Adhesives Components Coatings Seals Liners	Acrylic Phenolic Silicones Polyethylene Halogenated Vinyls

Propulsion

The solid propellant rocket had its start back in the 12th Century A. D. and its appearance has changed very little since then (Figure 3,

below). A solid propellant charge, enclosed by a "bottle," burns to furnish gases which are exhausted through a nozzle. The resulting thrust moves the rocket in a direction opposite to the gas flow.

Early rockets used charges of gunpowder which were later replaced by nitrocellulose and nitroglycerin (double-base propellants). However, these double-base materials were expensive, difficult to work with, and usually were in critical supply in times of emergency. Then composite propellants came into being. These composites use a finely divided oxidant salt with a plastic fuel-binder. An early composite contained ammonium picrate-sodium nitrate with a urea-formaldehyde resin binder. However, a less expensive and more widely used propellant has potassium perchlorate as the oxidant and a mixture of oil and asphalt as a fuel-binder. Although the result is thermoplastic, it provided the basis for casting large charges. When newer resins became available at lower costs, thermosetting and castable solids became feasible. For example, an Aerojet-General smokeless propellant uses ammonium perchlorate and polyester resin (Aeroplex), and Thiokol Chemical Corp. is using its polysulfide resins extensively in solid propellants. Other propellant researchers are working with epoxies, vinyls, polyurethanes, synthetic rubber, and other lower-cost materials. Thanks to modern plastics technology, it is now possible to produce single charges or "grains" of almost unlimited size which can compete with liquid propellants.

The ideal plastic fuel-binder should be readily available and low in cost, but other factors must also be met. For one, the plastic should be as oxygen- or hydrogen-rich as possible for good combustion properties. This is because most propellants have to be about 70 to 90% oxidant (with 20 to 60% available oxygen for combustion). Then, the binder should allow workable mixtures (preferably castable or extrudable) at high filler (oxidant) concentrations. In addition, the cured fuel-binder has to be strong enough to hold the propellant together at high temperatures (2000 to 5000° F.), pressures (500 to 3000 p.s.i.), and varying ambient temperatures (—40 to 160° F.). The many problems associated with the use of plastics under these conditions have largely been solved and any new combinations must meet the properties of existing propellants.

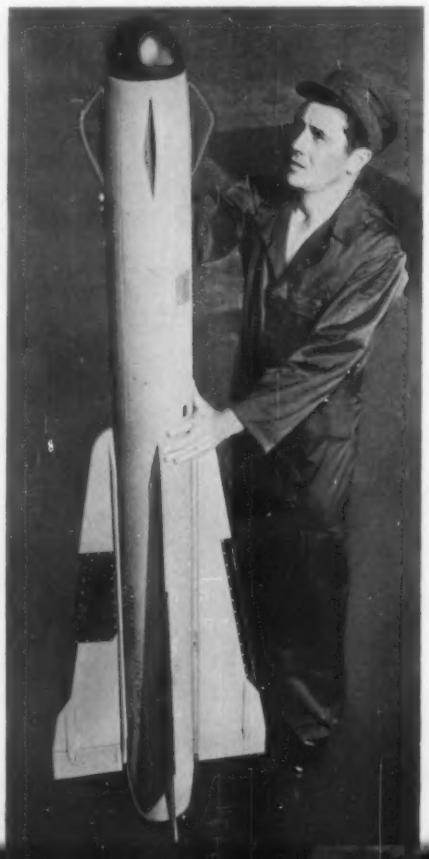


Fig. 4: Plastics are used on the *Falcon* missile in radome, guidance equipment, and propellant. (Official U. S. Air Force Photo)

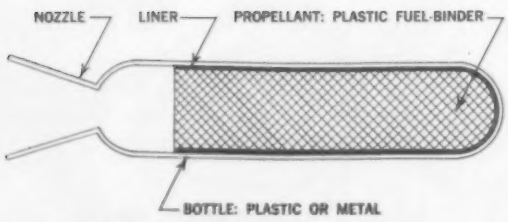


Fig. 3: Diagram of a solid-propellant rocket. Plastics play an important part in the operation of this type of missile

Table II: The missile market

Name	Activity*	Name	Activity*
Aerojet-General Corp., Azusa, Calif.	SPR, LPR	Hercules Powder Co., Wilmington, Del.	SP
Aerophysics Development Corp., Santa Monica, Cal.	SPR, LPR	Hughes Aircraft Co., Culver City, Cal.	MS, C, E
AiResearch Mfg. Co., Los Angeles, Calif.	AUX	International Business Machines, New York, N.Y.	E
American Machine & Fdy., New York, N.Y.	AUX	M. W. Kellogg, Jersey City, N.J.	LP, C, L
American Rocket Co., Wyandotte, Mich.	SP	Lear, Inc., Santa Monica, Calif.	E
Armour Research Lab., Chicago, Ill.	SPR, LPR	Lockheed Aircraft Corp., Burbank, Calif.	MS
Atlantic Research Corp., Alexandria, Va.	SP	Marquardt Aircraft Co., Van Nuys, Calif.	MS
Bell Aircraft Corp., Buffalo, N.Y.	SPR, LPR	Glenn L. Martin Co., Baltimore, Md.	MS
Bell Telephone Labs., Murray Hill, N.J.	MS	McDonnell Aircraft, St. Louis, Mo.	MS
Bendix Aviation Corp., Detroit, Mich.	MS	Northrop Aircraft, Hawthorne, Calif.	MS
Boeing Airplane Co., Seattle, Wash.	MS	North American Aviation, Los Angeles, Calif.	MS, LPR, SPR, C, E
Bulova Res. & Dev. Labs., Flushing, N.Y.	MS	Olin Mathieson Chemical Corp., New York, N.Y.	SP, LP
Chance Vought Aircraft, Dallas, Tex.	MS	Philco Corp., Philadelphia, Pa.	E
Chrysler Corp., Detroit, Mich.	MS	Phillips Petroleum Co., McGregor, Tex.	SPR
Convair, San Diego, Calif.	MS	Radio Corp. of America, Camden, N.J.	E
Curtiss Wright Corp., Caldwell, N.J.	LPR	Radioplane Co., Van Nuys, Calif.	MS
Douglas Aircraft, Santa Monica, Calif.	MS	Ramo-Wooldridge Corp., Los Angeles, Calif.	MS
East Coast Aeronautics	L	Rand Corp., Santa Monica, Calif.	MS
Experiment, Inc., Richmond, Va.	SP, LP	Reaction Motors, Inc., Denville, N.J.	MS, SPR, LPR, AUX, C
Fairchild Engine & Airplane, Wyndanch, N.Y.	MS, L	Republic Aviation Corp., Farmingdale, N.Y.	MS
Firestone Tire & Rubber, Akron, O.	MS	Ryan Aeronautical Co., San Diego, Calif.	MS, LPR, AUX
Food Machinery & Chemical, New York, N.Y.	LP	Southwest Research Institute, San Antonio, Tex.	SPR, LPR
General Electric, Schenectady, N.Y.	SPR, LPR, MS, C	Thiokol Chemical Corp., Trenton, N.J.	SPR
Goodyear Aircraft Corp., Akron, O.	C	Union Carbide & Carbon, New York, N.Y.	LP
Grand Central Rocket Co., Redlands, Calif.	SP	Wyandotte Chemicals Corp., Wyandotte, Mich.	LP

*Key: SP=Solid propellants. SPR=Solid propellant rockets. LP=Liquid propellants. LPR=Liquid propellant rockets. C=Components. MS=Missile systems. L=Laminates. E=Electronics. AUX=Auxiliary systems.

A rough estimate of the amount of plastics used as a fuel-binder would be around 1,000,000 lb. a year. In addition, plastics are used for lining bottles and for cementing charges into place. Some success has been had also in replacing conventional metal bottles with laminated plastics. The M. W. Kellogg Co. has reported fabrication of an epoxy-glass booster rocket, while Fairchild Engine & Airplane Co., has done some work on a plastic bottle for jet-assisted take-off use on aircraft. In addition, work has been reported on a frangible plastic bottle for the *Nike* missile booster rocket.

Continuing work along these lines indicates that much plastic will go into future solid-propellant missiles. Indeed, present missiles such as the *Falcon* (Figure 4, opposite), which has a plastic radome, uses plastics in guidance equipment and burns a plastic Thiokol propellant.

Hybrid and liquid rockets

Going up in complexity is the solid-liquid or hybrid rocket, in which a liquid oxidant is sprayed on a cast or machined plastic (Figure 5, below). The Pacific Rocket Society, Los Angeles, was a pioneer in this field, using liquid oxygen and cast poly- (*To page* 284)

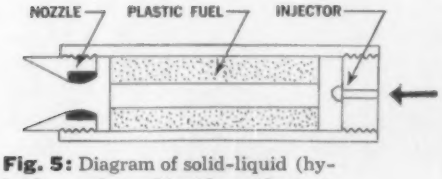
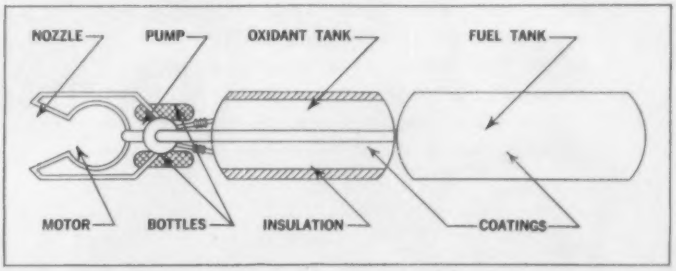


Fig. 5: Diagram of solid-liquid (hybrid) rocket. Liquid oxidant is sprayed on cast or machined plastic

Fig. 6: Diagram of liquid-type rocket. Applications of plastics in this type missile include seals, liners, gaskets, expansion joints, insulators, coatings





Vast numbers of thin-gage triacetate records are now being used annually by many firms to advertise, merchandise, and promote their various products. (Photos, Eastman Kodak Co.)

Records by the millions

Thin, tough acetate recordings, merchandised as premiums or advertising media, provide high-fidelity reproduction, have long play-back life

*By Jack Brown**

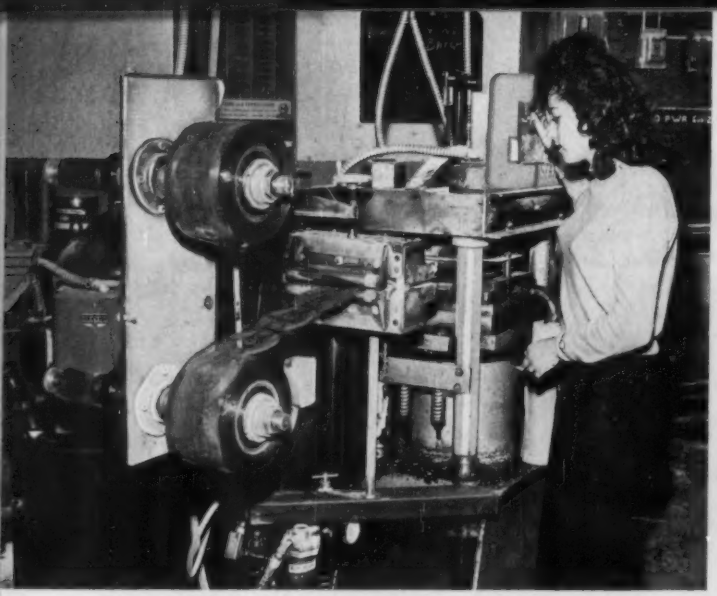
In the record trade, a quarter of a million copies spells a hit—and only a few recordings ever make this select circle.

With new super-thin cellulose triacetate records, introduced last year, however, million-copy sales have become virtually commonplace. Just about every record turned out, even of an old standby such as "Take Me Out to the Ball Game," is an assured hit before it comes off the presses.

That's because these records are being distributed via such unorthodox and diversified media as cereal boxes, magazines, and pop bottle necks. As novelty premiums or as a means of complementing a visual selling message with an audio appeal, the thin, tough records have already scored a phenomenal success in the merchandising field. General Mills, for one, has within the past year used some 14 million of the records as a premium item affixed to Wheaties cereal boxes—and a re-order totaling almost twice that amount is in the works.

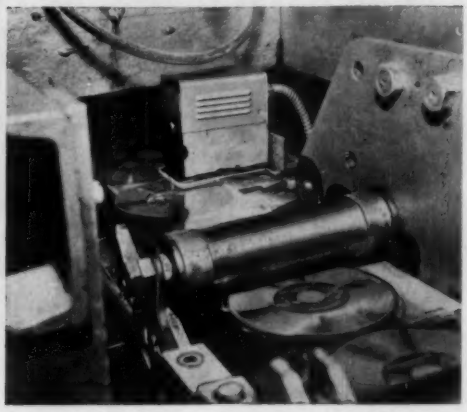
So widespread has been the interest in the

*President, Rainbo Record Manufacturing Corp., Lawndale, Calif.



Preprinted triacetate record film is fed to press from rolls, pressed, and re-rolled, ready for editing. Operator watches registration

Electric eye (center) automatically controls feeding and pressing of continuous triacetate record rolls



idea that we have retired our lacquer vats and conventional pressing equipment to concentrate entirely on turning out the new thin acetate records.

Cellulose triacetate

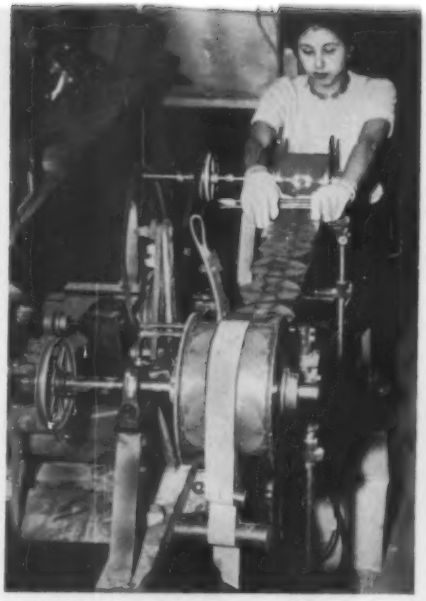
In meeting the specialized requirements of these recordings, Kodapak IV cellulose triacetate film supplied by Eastman Kodak Co., Rochester, N. Y., has proved to be the ideal material. The film is basically the same as that used in movie making, but is modified by the addition of more plasticizer and by other changes in the formula.

Actually a recording can be pressed on almost any material, including paper, wood, or even cloth. To be salable, however, the record must have fidelity and low noise-to-signal ratio —and it is here that a basic advantage of cellulose triacetate film shows up. In quality, the acetate records are the equal of the finest virgin thermoplastics records used in molding today's best high-fidelity recordings.

The fact that cellulose triacetate film as thin as 3 mils can be used without impairing the quality of sound reproduction also means important savings in shipping and in assembly to the finished product. The thin-gage records can be shipped in roll form (260 records to the pound) and easily affixed by the customer di-



Musical map shows view of Disneyland at bottom, has five triacetate records pasted along top, each describing part of Disneyland



Roll of records is edited by operator who checks registration against a preprinted background

Machine set-up for cutting individual records from roll. Records are then ready to be mounted as part of children's story books, on cereal boxes, etc.



rectly to the cardboard box or cardboard insert. Despite its thinness and light weight, the record is still tough enough to take the handling and abuse generally accorded premiums of this type. And the glass-smooth grooves that are pressed into the cellulose triacetate film will still give excellent reproduction even after repeated playings.

To gear output to the million-unit level demanded by premium applications, high-speed electronically controlled presses have been designed to handle production of the records. We have four presses that are working around the clock every day to turn out more than 2 million records per week.

Production techniques

To take advantage of mass production economies, the cellulose triacetate film is fed through the press in roll form. When guide marks printed on the edges of the plastic web pass under an electric eye installed in the press, the web is automatically halted just long enough for the platens to converge and impress the recordings on the film. The pressing operation takes only about one second; the molds then part and the web moves on to the next position. This rapid embossing rate—50 records are handled per minute—is made possible through direct heating of the tri-cellulose acetate film. An anti-static device is used to overcome the effects of the static electricity that builds up on the moving film.

During the pressing, the machine operator keeps a continuous check on register. Where the web has been preprinted with labels or circular patterns, as is the case with some of the new children's records, a divergence of more than $\frac{1}{32}$ in. either way would be serious. When the roll of records is later cut up on high-speed machines, a spread greater than $\frac{1}{32}$ in. between printing and grooves would result in the records being cut apart at the wrong point. Hand manipulation of the web as it feeds into the pressing machine will frequently correct any difficulties of this nature. A slight pressure of the hand will often bring the web into alignment.

As each strip emerges from the press, the operator marks any imperfections, splices, or poor registers with a tab. These tabs protrude from the side of the roll and serve as a signal to the operator who will later edit the roll.

On some of the machines at the Rainbo plant, the impressed webs are automatically rewound onto new rolls as they emerge from the pressing equipment. When a roll is completed, it is removed from the machine and sent to the editing department.

Editing the recordings

In editing, each roll is mechanically unwound and then re-fed onto a new spool. As the web unwinds and passes over the editor's work table, it is the function of the editor to check for tabs and other imperfections in the recordings that the pressing operator may have missed. When a faulty spot shows up, the apparatus is stopped and the offending section is cut out. The roll is then re- (*To page* 273)

Reinforced molding compounds—part 2: fibers help phenolics, melamines, and silicones to move into bigger fields

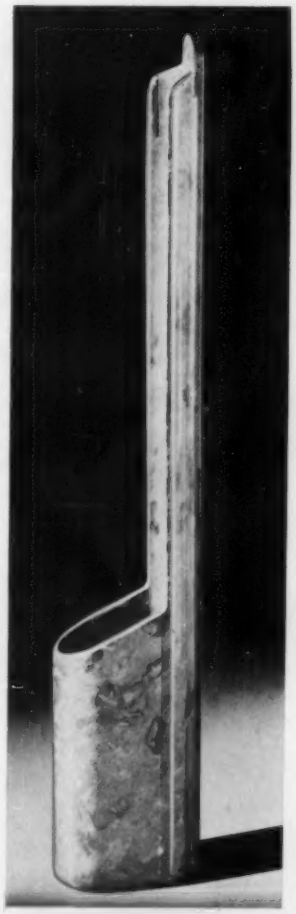
Growth in the field of reinforced phenolic, melamine, and silicone molding compounds has been nowhere near as spectacular as in the field of reinforced polyesters, epoxies, and alkyds (see MODERN PLASTICS 33, 91, Aug. 1956)—but the end results from the standpoint of new market development and exploitation have been pretty much as satisfactory.

Where the reinforced polyester, alkyd, and epoxy compounds have jumped into prominence within a short, excitement-packed three-year period, the other reinforced thermoset compounds have moved more cautiously over a longer period of time. For well over two decades, wood flour-"filled," cotton flock-"filled," asbestos-"filled" phenolics, etc., have been available, while alpha-cellulose "filler" for melamine resins has been around almost as long as the resin itself.

However, it was not until the appearance of the reinforced polyesters stimulated a strong interest in reinforced plastics materials of all types that the sales curve in reinforced phenolic, melamine, and silicone really started upward. Today, this phase of the reinforced plastics industry is showing more life than probably ever before in its relatively long history. As with the polyesters, development work is going forward at an accelerated pace to meet the demands of the most critical consumer and industrial applications.

In order to take advantage of the current interest in *reinforced* plastics, the suppliers of high-impact phenolics, silicones, and melamines have adopted terminology common to the polyester and epoxy fields. At one time—particularly as it applied to the phenolics—fibers, wood flour, etc., added to the resin were classified as *fillers*. Today, a more exacting line is being drawn by the trade between reinforcements and fillers. Any inexpensive, inert substance added to the plastic to make it less costly is known as a filler; any strong, inert material bound into a plastic to improve its strength, stiffness, impact resistance, or other physical, chemical, or electric properties is known as a reinforcement. Since fillers often change the characteristics of the finished product, there is naturally some overlap between the functions of filler and reinforcement. With increased use of the medium- and high-impact materials, however, and as a more specific body of engineering data is built up, the line between the two can be expected to be brought into sharper focus.

Reinforcements currently used for phenolics, melamines, and silicones, include glass, cotton, asbestos, sisal, and various synthetic fibers. Paper is used as a reinforcing filler in phenolics



One-piece cup case for an industrial thermometer is molded of phenolic-glass material. (Photo, Durez)

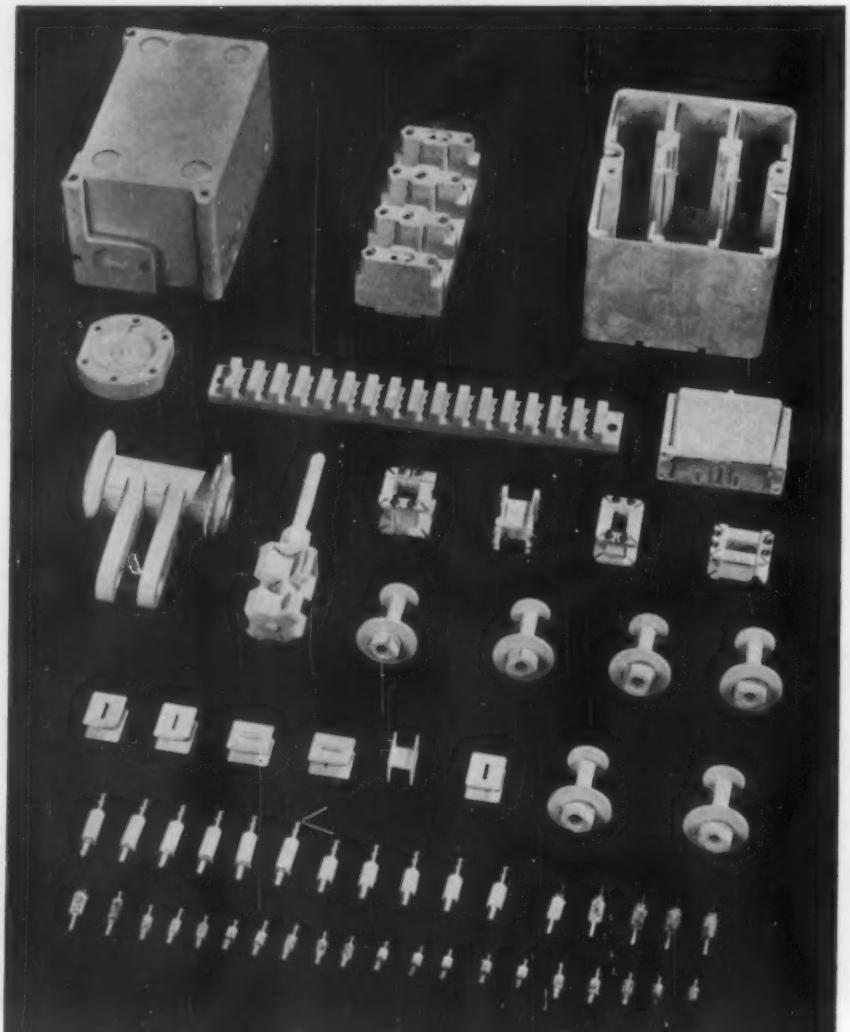
to give added wear resistance and alpha cellulose is used in melamine molding compounds for the production of dishware.

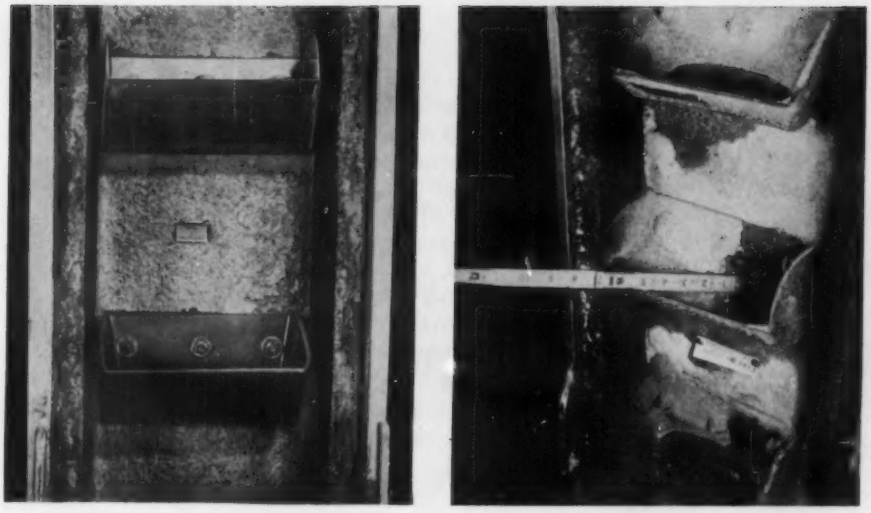
Base resins

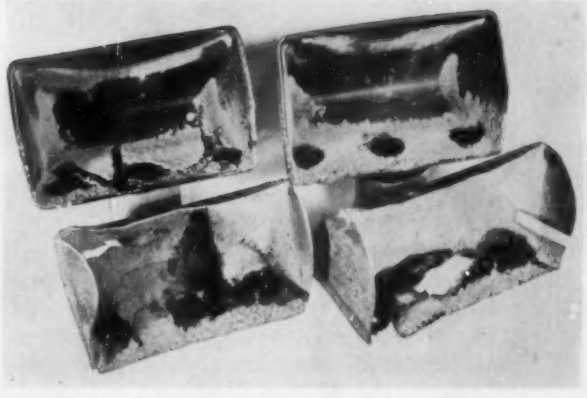
When these reinforcements are added to the base resin, a compound is produced which gives general durability superior to that possible with the general-purpose molding compounds. While the reinforced materials are generally higher in cost than general-purpose, the strength imparted to the compound by the reinforcing fibers makes it possible to thin down wall sections in the finished product, thereby equalizing materials costs, reducing weight, and decreasing curing time.

Phenolics are the largest in volume and most important of the three reinforced thermosets under discussion here. As a base resin, they provide excellent dimensional stability, good acid resistance, excellent electrical properties, high heat resistance, and excellent surface finish, and are generally uniform in strength, shrinkage, and homogeneity. By selecting the proper reinforcement, any one of these characteristics can be emphasized to meet specific application demands. Recent advances in reinforced phenolics, for example, have carried them into higher temperatures than were heretofore possible, and further work in this direction is underway. Work for the various branches of the Armed Services has resulted in successful use of molded glass-phenolic parts at temperatures up to 7000° F. for very short

Typical electrical end-use products molded of fibrous glass-reinforced melamine formaldehyde material include heavy-duty switch gear, terminal strips, stand-off insulators, and various coil forms. (Photo, American Cyanamid Co.)







Results of tests to evaluate the relative merits of metal and reinforced phenolic conveyor buckets in transporting grain feed. In top left photo, buckets are shown installed on elevator leg, metal bucket at top, phenolic bucket at bottom. Top right photo shows buckets after two months' operation; metal bucket (in center) has considerable caked residue; plastic buckets are above and below. Photo at right shows two plastic buckets (at top) and two metal buckets (at bottom) after identical service periods. For details of test, see "Case study," p. 158. (Photos, Fiberite Corp.)

periods of time. In these applications, the phenolic parts act as insulators and prevent high-tempered steel casings from overheating. Parts for continuous use at temperatures of 500° F. are also being molded today of glass-phenolic materials.

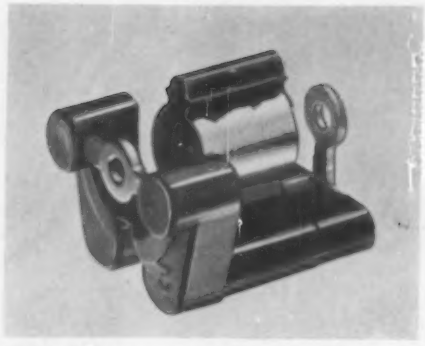
Essentially, it has been developments of this nature—both in resin formulations and in selection of reinforcing fiber—that have caused reinforced phenolics to blossom forth after all these years with such exciting new potential. And development work is far from over. Only recently, sisal fibers entered the picture as a means of imparting impact strength and low specific gravity, with the possibility of molding at reduced pressures—and low material cost.

Producers of reinforced phenolic molding compounds include: Durez Plastics Div., Hooker Electrochemical Co., North Tonawanda, N. Y.; Fiberite Corp., Winona, Minn.; and Rogers Corp., Rogers, Conn.

Melamine resins for reinforced molding compounds have the advantage of unlimited color possibilities, excellent arc resistance, good alkali resistance, fire resistance, and a hard surface. The largest volume of reinforced melamine molding compounds is used today in the form of the alpha-cellulose melamine for dishware. More recently, fibrous glass has entered the picture as a means of improving the strength and electrical characteristics of the materials for such applications as heavy-duty switch gear, terminal strips, coil forms, etc.

Producers of reinforced melamine molding compounds include: American Cyanamid Corp., New York, N. Y., and Fiberite Corp.

Silicone-glass molding compounds, one of the newer entries in the field, are used primarily to produce electrical (Class H electrical insulating components), electronic, and mechanical parts that retain exceptional electrical and physical properties at high temperatures. Dow-Corning Corp., Midland, Mich., for example, claims that its 301 material has a flexural



Molded-in lugs reduce cost for reinforced phenolic electric meter bracket. (Photo, Rogers Corp.)

strength of 5000 p.s.i. and an impact strength of 11 ft.-lb./in. of notch at temperatures of 200° C. (392° F.)

Producers include: Bakelite Co., New York, N. Y.; Dow-Corning Corp.; and General Electric Co., Pittsfield, Mass.

Proper evaluation

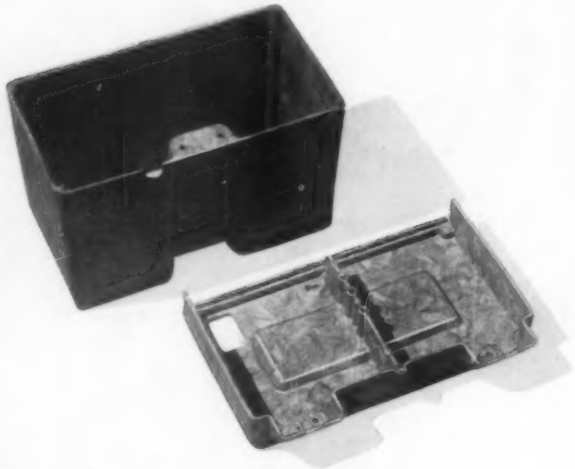
Much of the future for the reinforced thermosets is tied up with the development of a solid body of engineering and application data that will permit the end-users to select the "right plastic for the right job." As described above, each base resin offers specialized characteristics to meet specific demands. The selection of the correct reinforcing fiber will also have a significant bearing on the success or failure of the end product.

Glass fibers are used, for example, for heat and flame resistance, immunity to fungus and bacteria, chemical and water resistance, strength, and dimensional stability. Cotton flock, fabrics, and cords are best [other than glass] for dimensional stability, uniformity of impregnation, and good surface appearance—and are low in cost. Nylon reinforcements, compared with cotton flock, fabric, and cord give lower water absorption, slightly higher flexural strength, higher tensile strength, lower compressive strength, lower heat distortion, lower modulus of elasticity, and improved electrical properties. (It must be pointed out, however, that control of shrinkage is a molding problem when nylon fibers are used.) Sisal, when used as a reinforcement, has a big edge in cost, but its physical properties are inferior to those of most other fibers. Asbestos reinforcing fibers are added primarily to give good strength characteristics, heat resistance, and dimensional stability, wearing characteristics, and chemical and water resistance.

Case study

A successful case study reported by Fiberite Corp., Winona, Minn., will serve to illustrate the responsibility which rests on the raw material supplier, molder, and end-user to select the proper material for the specific needs.

The problem at hand was the design and construction of a conveyor bucket for handling grains, cereals, and other feed. As used by National Oats Co., E. St. Louis, Ill., buckets of this type carry hot, moist feed pellets from a mill where they are treated with pressure and steam to a second unit where they are cooled to room temperature. The metal buckets then in use had a service life of not more than one year because of corrosion. In addition, the steamy pellets would leave a residue in the bucket that eventually built up into a cake which had to be removed every month by hand.



Radiosonde case, molded of glass-reinforced phenolic, carries weather recording gear into stratosphere. (Photo, Durez)

After a two-year evaluation program, it was decided that plastics materials were the answer to all of these problems. The question then arose as to which plastic to use.

The idea of using thermoplastic sheet stock was eliminated because of the high temperatures and the various chemicals and solvents which would be encountered by the bucket in

operation. And because of the high impact strength required, it was further decided that any thermoset to be used would have to be reinforced.

A one-cavity compression mold was then built and a number of prototype buckets of various reinforced thermosets were turned out for field and laboratory evaluation in order to select the best material.

Of the various materials tested, ureas were first eliminated because of general brittleness, only fair weathering tendencies, and the fact that reinforcing fibers were not generally used in conjunction with these resins. Melamines showed excellent potential for the application, but price proved to be a deterrent.

Physical tests

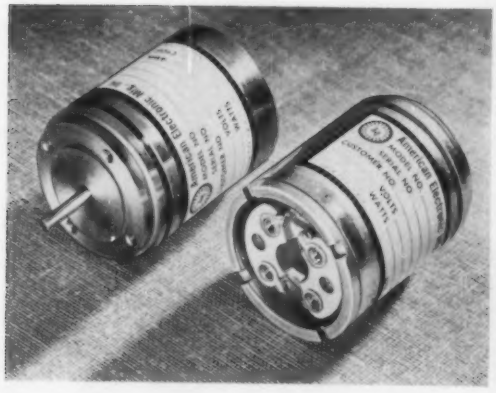
The selection was thus confined to the reinforced polyesters and the reinforced phenolics. Because of the peculiar requirements of the application, a series of tests on abrasion and wear were conducted by Fiberite making use of a Wheelabrator. When 40-mesh steel grits were used, the following results were noted: the fabric-reinforced phenolic part had a loss in weight after 3 hr. of 6%, the glass-reinforced phenolic part, 7%, and the glass-reinforced polyester part, 20 percent. In an accelerated wear test, a rotating (1200 r.p.m.) steel shaft was made to bear on small blocks of the molded materials. A developed pressure of 800 p.s.i. was used and water lubrication was used to keep frictional heat from invalidating the tests. None of the materials were internally lubricated to improve wear. Results of this test were as follows: after 24 hr., the fabric-reinforced phenolic showed a depth of wear of 0.040 to 0.156 in.; the glass-reinforced phenolic, after the same length of time, showed a depth of wear of 0.016 to 0.050 in.; after 3 hr., the glass-polyester blocks showed a depth of wear of 0.500 inch.

On the basis of these tests, it was decided to mold the bucket of reinforced phenolic. Three types of reinforcement were then tested—flock, lightweight fabric, and heavyweight fabric. After a 4-yr. field evaluation, the flock-reinforced phenolic bucket, although it wore well, broke in use; the lightweight fabric-reinforced phenolic bucket showed borderline results; and the heavyweight fabric-reinforced phenolic proved the most effective.

The finished conveyor bucket (molded of heavyweight fabric-reinforced phenolic) resulting from this long series of evaluation tests is today being marketed under the tradename of Dura-Buket to the feed industry. Unlike metal buckets, the plastic product will not rust or corrode when subjected to moisture or a large majority of chemicals. During field tests on the conveying elevator (see photos, p. 157), the bucket outlasted its metal counterpart by five times. The plastic bucket also will not give rise to static sparks, thereby eliminating danger of dust explosions. Because of (*To page 274*)



Washing machine sprocket, used with chain drive, is molded of fibrous glass-reinforced phenolic. (Photo, Fiberite Corp.)



Terminal blocks of glass-silicone are designed for aircraft and missile service. (Photo, American Electronics)

Styrene vials for single or dual packaging



Latest development in plastic vial design makes possible either single or dual packaging in one container. The container, consisting of threaded cap and body sections injection molded of polystyrene and joined by an aluminum coupling, provides a flexibility of design which facilitates packaging of difficult-to-package products. By inserting a separator in the aluminum coupling, the vial can be used for two different or related products.

To meet a wide variety of packaging requirements, the two threaded body sections are available in ten combinations of sizes, from 1 by 4 in. (2-in. cap with 2-in. body) to 1 by 8 in. (4-in. cap with 4-in. body). Other combinations of cap and body sizes are available on order.

For special applications, the vials can be made of polyethylene, cellulose acetate, etc., and are available in colors, both clear and opaque.

Credit: Lermer Plastic Coupl-Vials manufactured by Lermer Plastics, Inc., Garwood, N.J.

PLASTICS

Styrene-acrylonitrile rug protectors





A new type of rug protector, molded of C-11 styrene-acrylonitrile copolymer, is designed especially to prevent furniture legs from making indentations in tufted carpeting. The protectors are molded with more than 100 tapered teeth on the bottom surface which gently push aside the pile of a tufted carpet without crushing the fibers; at the same time, weight is distributed over an area 2 in. in diameter so that the short teeth do not pierce the carpet's backing. According to the manufacturer, three of the protectors will support a 1500-lb. grand piano on the finest carpet without leaving a permanent mark.

The high impact resistance of the styrene-acrylonitrile copolymer prevents cracking or chipping by carpet sweepers or vacuum cleaners. The protectors are available in three colors.

Credits: Carpetmates manufactured by Childlore Co., Kansas City, Mo.; Bakelite C-11 plastic supplied by Bakelite Co., New York, N. Y.

Silk screen frames

More uniform silk screen reproductions and better registration when more than one color is being applied can be achieved through the use of a new molded phenolic silk screen frame. Around the edge of the new frame is a molded-in groove for fastening the silk in position by the "cording-in" method; a cord wedged into the groove holds the silk securely and firmly in place. Since the cording groove has a smooth bevel, the silk may be stretched taut without danger of tearing.

Among the many advantages offered by the phenolic frames as compared to wood frames are: low cost, greater uniformity and strength, ease of cleaning and keeping clean, light weight, ease of storage, reduction in screenmaking time, and freedom from attack by solvents used in removing ink.

Credits: Manufactured by Tipp Supply Co., Tipp City, Ohio; molded by Kurz-Kasch, Inc., Dayton, Ohio; phenolic supplied by Durez Plastics Div., Hooker Electrochemical Co., N. Tonawanda, N. Y.



PRODUCTS

Nylon skates, polyethylene straps

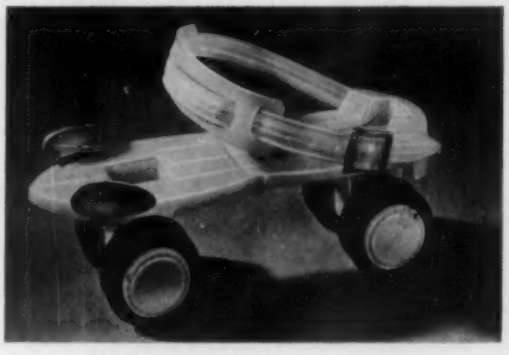
In a radical departure from traditional materials used in roller skate construction, Manning Mfg. Corp., Chicago, Ill., is producing skates composed entirely of molded nylon parts. The new skates, made in two sizes, are sleek and attractive in appearance; in addition, they are light in weight, strong, rustproof, non-breakable, self-lubricating, and safe to use.

The chassis of the skates, made up completely of nylon parts, is easily adjusted for size with a single tension nut. The wheels are also molded of nylon. In one model the bearings are plain; in the other, double race ball bearings are used. Molded nylon hub caps cover both the inner and outer sides of the wheels, enhancing appearance and keeping dust and grit out of the bearings.

The ankle strap and instep pad are made of soft, flexible polyethylene; they are waterproof, tearproof, and rotproof. A tongue-and-groove buckle provides secure fastening to the ankle.

The skates, available in red, yellow, green, pink, and white, retail at $7.95 for the large model, $3.95 for the beginner's model.

Credits: Zytel nylon and Alathon polyethylene supplied by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.



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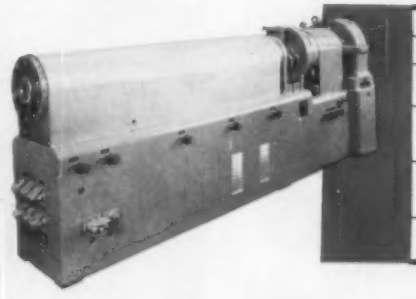
	DESCRIPTIVE DATA				
	Series 2000	Series 2800	Series 3500	Series 4500	Series 6000
*NOMINAL CAPACITY Lbs. Per Hour	100	225	400	750	1500
DUAL WORMS	each: 2" dia.	each: 2.8" dia.	each: 3.5" dia.	each: 4.5" dia.	each: 6.0" dia.
FEED INLET AT WORMS	3½" dia.	5" dia.	6" dia.	8" dia.	10" dia.
DRIVE MOTOR FOR STANDARD DUTY MACHINES	10 HP	25 HP	50 HP	100 HP	—
DRIVE MOTOR FOR HEAVY DUTY MACHINES	—	—	75 HP	150 HP	300 HP
FLOOR SPACE (Exclusive of Motor)	2' x 7'	3' x 8'	3'6" x 10'	4' x 14'	5' x 20'
WEIGHT OF MACHINES	2500 lbs.	4000 lbs.	6000 lbs.	8000 lbs.	28000 lbs.
*Actual capacities may be higher or lower depending upon the material processed.	The information listed in this table is equally applicable to the Compounder-Extractor-Extruder and to the Compounder-Extruder. Each is available in all sizes.				

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Barrel Length— L/D Ratio	20	20	20	20
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Nominal Capacity Lbs./Hr.	105 to 180	165 to 285	275 to 475	500 to 850
Approx. Weight	3600 Lbs.	5500 Lbs.	7000 Lbs.	8200 Lbs.

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Plastics Engineering

Dr. James F. Carley, Engineering Editor

Molten-bead heat sealing

Bead of melt from small extruder is pinched between films to make a strong seal at high speed

A new method of heat-sealing, particularly well adapted to sealing continuous films of polyethylene, has been developed at Bakelite's packaging laboratory in Bound Brook, N. J. The method consists of feeding a continuous bead of molten polyethylene between two layers of film to be sealed.

Conventional methods of heat sealing produce a seal or seam by melting localized regions of the two films. This may be accomplished by placing the films in contact with a hot surface or by heating them dielectrically. Unfortunately, polyethylene has so small a dielectric loss factor that the second method is impractical for sealing films of this material. When it comes to contact heating, polyethylene, like most plastics, has a low thermal diffusivity that keeps the heating rates low. Sealing rates have consequently been limited to 25 ft./min. with 10-mil film and 150 ft./min. with 1.5-mil film.

In the molten-bead method, the heat is supplied in the bead itself, which is extruded at 250° C. from a vertical bench-model extruder having a ¾-in. screw and a die orifice 1/16 in. in diameter;

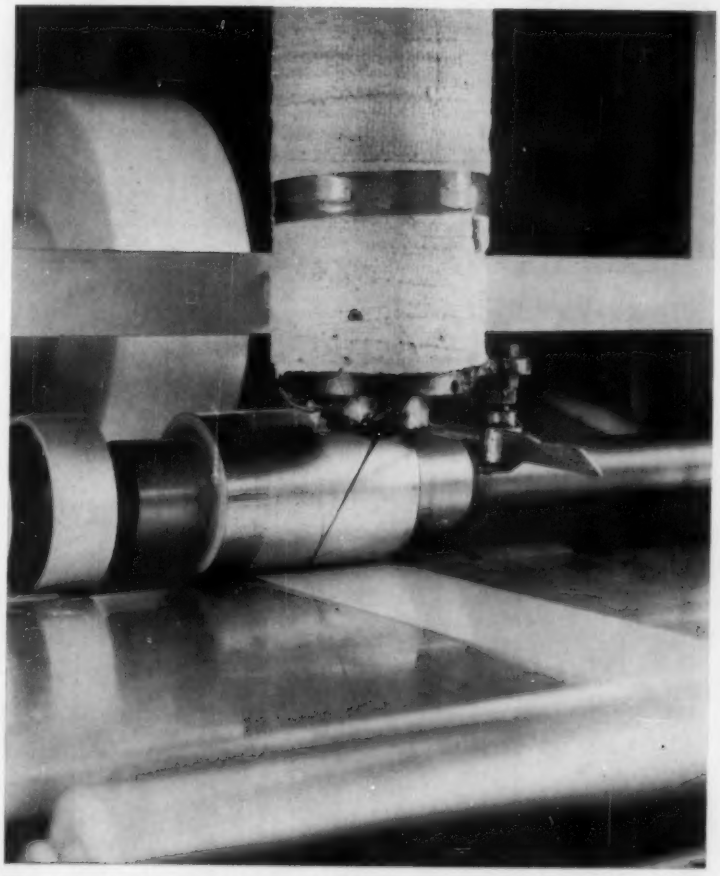


Fig. 1: Close-up of molten-bead heat sealer in operation. For visibility, black polyethylene is being used for the bead. Blade at right of die is used to wipe die face so bead will extrude cleanly

*Reg. U. S. Pat. Off.

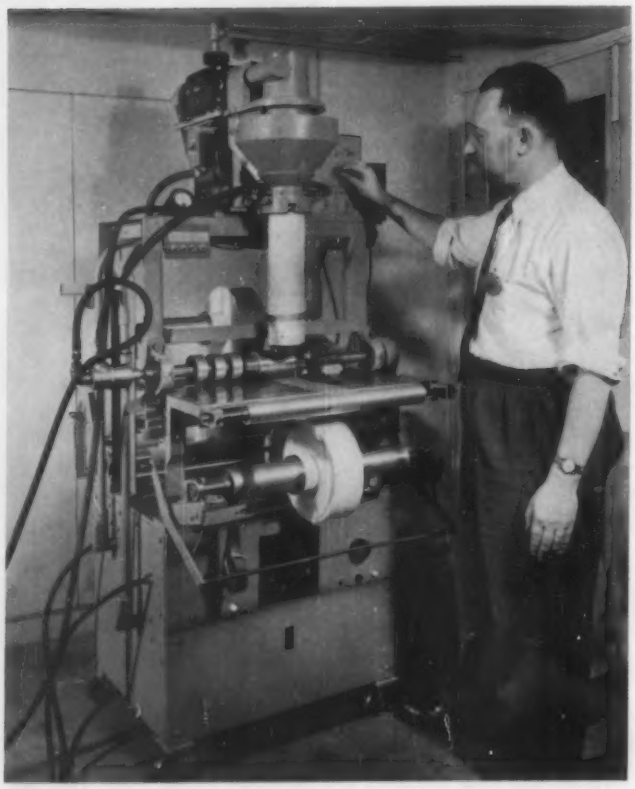


Fig. 2: Over-all view of a molten-bead heat sealer. The compact, portable unit is welding two strips of polyethylene film but the clear polyethylene melt-bead is too transparent to be seen in photo

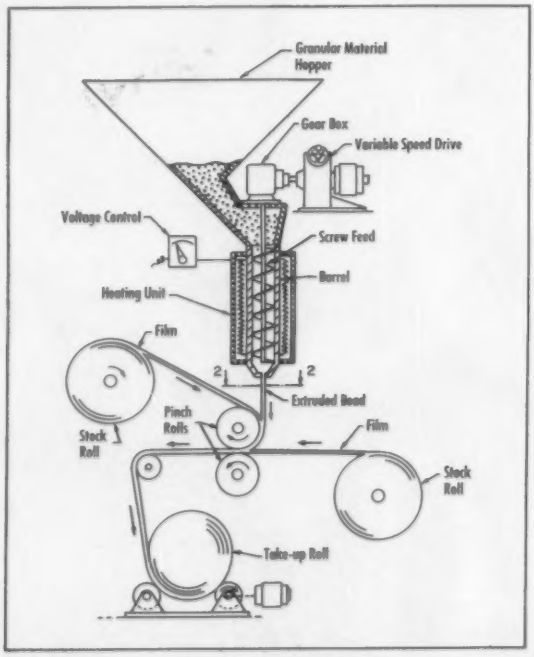


Fig. 3: Schematic diagram of molten-bead sealer. Where multiple seals are to be made, slitting equipment would be added to set-up

the hot bead hits the films and is flattened by light pressure between two rollers. As it gives up heat to the film, the film layers near the interface are fused into a strong continuous weld. Films of almost any thickness can be sealed at rates of 500 ft./min. or more. In Figs. 1 and 2, two strips of film are being welded by this method. Figure 3 is a diagram of the heat-sealing set-up.

Strong seals easily made

Good seals can be obtained at a wide range of film speeds without altering the output of the melt bead. Figure 4 shows photomicrographs of two seals made with a bead extruded at about 1.5 lb./hr. The seal shown in the upper photo was made at a rate of 100 ft./min., while the lower photo shows films sealed together at 400 ft./min., other conditions being the same. Thus, while a minimum of hot melt is needed to get a good seal, use of more material will merely increase the width and thickness of the seal. Such wide limits of film speed might not be possible with less elastic melts without compensating adjustment of bead extrusion rate. But such adjustment is simple.

The minimum size bead is one that contains enough sensible heat above its melting "point" so that some of the adjacent polymer in the films is melted before the bead itself freezes. Since the heat from the bead moves into the sheet by conduction, and since only the layers close to the interface need be melted to achieve a good bond, the sheet thickness is not an important factor in making the bond, so a single bead size will serve all thicknesses equally well.

The molten-bead sealer gives bond strengths at least as high as those obtained by any other method. Some conventional sealing methods, in order to obtain good heat-conductive contact, apply enough pressure to thin the film at the point of sealing, thus weakening it. Melt-bead sealing does not thin the film at all, as Fig. 4 shows.

The possibilities

Melt-bead sealing is best suited to making long straight seams between films, coated papers, or

laminates. It is easily adapted to making multiple seals by using a die with multiple holes. In this way it is possible to seal wide films along many lines, then slit the films to get many narrower tubes, as in Sketch C of Fig. 5. Extra-wide films may be made by lap-sealing two narrow strips, as in Sketch D, or by butt-sealing them as in Sketch H. Workable sealing methods for coated materials are shown in Sketches E, F, and G. It is doubtful that melt-bead sealing will be useful in making short seals or seals requiring frequent changes in direction.

While the method has been applied so far only to polyethylene films and polyethylene-coated papers and laminates, the principle should be applicable to other thermoplastic compositions. However, the excellent thermal stability of polyethylene makes it especially easy to work with in melt-bead sealing, since it can be heated far above its freezing point, which is rather low. With higher-melting, less melt-stable materials, the method may fail. Some figures will make the point clear. Branched polyethylene is completely melted at about 115° C., its "molten point."[1] To heat a gram of the resin from 25° to 115° C. takes about 90 calories, while in cooling a gram from 250° to 115° C. the resin must give up about 95 calories. Apparently the available enthalpy above the molten point in the melt bead must be a little more than the increase in enthalpy needed to melt the cold film. (Some heat is lost between die and film.)

This balance is to be expected since, in order to get a seal, the layers in the flattened bead and the film immediately adjacent to the interface must quickly reach an equilibrium temperature in the melt range before everything freezes. Making the bead larger will probably not change the picture much, since it is spread over a greater width. Thus the melt-bead method may be expected to work well with plasticized vinyl, polystyrene, and cellulose acetate, which, like polyethylene, melt at low temperatures and can be safely heated far enough above their molten points to meet the enthalpy balance. But it may fail with films made of cellophane, nylon, Mylar, polytrifluorochloroethylene, etc., whose molten points are far higher. With such materials it will of course be helpful, and perhaps practical, to preheat the film to be sealed so as to reduce the excess enthalpy needed in the molten bead.

To sum up, the greatest usefulness of molten-bead heat sealing will be in making long, straight, continuous seals between films, sheeting, and laminates of the lower-melting, heat-stable thermoplastics.

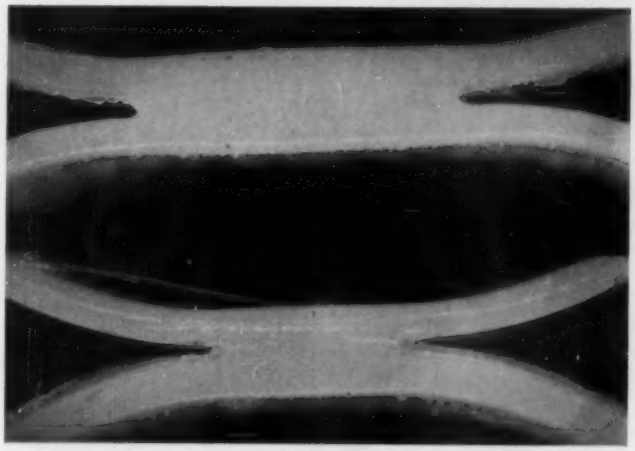


Fig. 4: Photomicrograph of polyethylene film, 10 mils thick, showing effect of lineal sealing rate on width and thickness of seal. Upper photo—100 ft./min.; lower photo—400 ft./min. Note absence of weld lines in both cases. (All illustrations, Bakelite Co.)

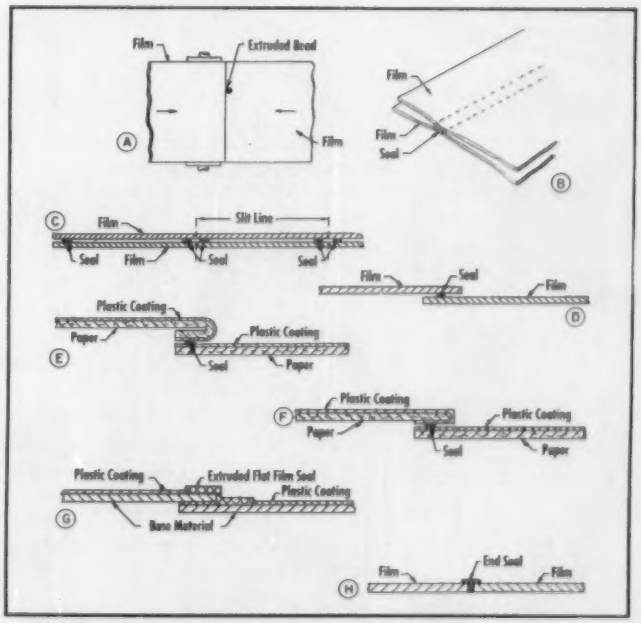


Fig. 5: Diagrams of some types of seals that can be made by the molten-bead heat-sealing method

[1]This term is introduced here because the term "melting point" is not really applicable to polymers, which begin melting at temperatures 20° C. or more below those at which they are just completely melted. The "molten point" refers to the upper limit of the melting range. This is the important temperature for heat sealing, since complete melting (on a local scale) is necessary for the greatest bond strength.

Runner and gate design

based on SS (successive simultaneity) guarantees

uniform molded parts

It is difficult in multi-cavity molding of precision parts to get parts having the same dimensions from the various cavities, even though the cavities themselves are identical. Worse than that, it frequently seems almost impossible, under reasonable molding conditions, to fill all the cavities. With growing pressure for the greatest possible machine productivity, machines are being pushed to their ultimate plasticating capacities. Under such conditions it becomes still harder to fill out the mold cavities evenly. By applying the known laws (1, 2)[1] of plastic melt flow it is possible to provide runner and gate layouts that will result in higher and more efficient machine output.

This design system is based on the principle of "successive simultaneity," or SS. It has three objectives: 1) the melt should reach all the gates at the same time; 2) the filling of all the cavities should be completed at the same time; 3) the gates should seal quickly and at the same time.

[1]Numbers in parentheses link to references listed at the end of article, p. 293.

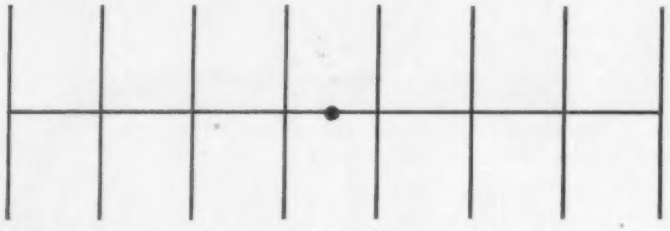


Fig. 1: Popular layout for a 16-cavity mold

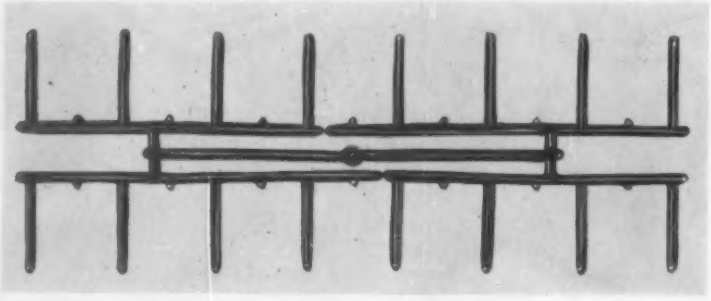


Fig. 2: Photo of improved layout for the same mold

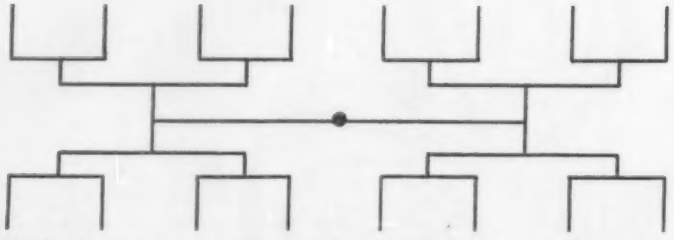


Fig. 3: Organization-chart runner layout equalizes runner-filling time, which differs by 88-fold for Fig. 1, 3-fold for Fig. 2

Why try for SS?

There has been an important emphasis in injection molding on using the smallest gates that will allow the cavity to be filled because small gates make finishing easier and less costly.[2] They also freeze very quickly and thereby minimize packing of the cavities. Runners, on the other hand, need not be made small unless they are so large a part of the shot weight that the percentage of scrap is very high, say 50% or more. With a scrap grinder right at the machine it costs very little more to rework 20% of the stock than it does to rework 10 percent.

Where there are differences in the time of arrival of the melt at the different gates, usually due to differences in runner length or flow rate, some of the melt reaching the first gate starts through the gate into the cavity while the remainder continues on to the other gates. A small gate offers so much additional resistance to flow that it may freeze while the runner system fills. A worrisome condition of "first come, last served" is set up. When the melt reaches the last gate the pressure jumps and the hot melt fills the last-reached cavities. In the meantime, the first-reached cavities may not be filling at all. When most of the cavities have been filled and the full melt pressure is brought to bear on these chilled gates, the cold plugs may be forced through, finally allowing the cavities to be filled. Or they may not open at all, and, when the mold is opened, these cavities will be empty. If the

[2]In some cases it is desirable to "pack" the mold cavity to prevent sinks and voids and to reduce shrinkage; then the gate should not freeze until the piece itself has cooled into the freezing range. Such gates must be large and may be so large as to offer negligible restriction to the flow. Where a lot of packing is necessary, there is little need for SS.

number of empty cavities is a fair fraction of the total, the shot will have been small enough so that the melt temperature of the next shot will be a little high—high enough so that some of the previously empty cavities are filled. Under such erratic operation, controlled molding is impossible. Even the pieces taken from the cavities that regularly fill will vary in size more than they should.

In a similar layout, the gates may be large enough so that even under the low pressure available while the runners are filling, melt will ooze slowly into the first-reached cavities. This material begins to cool and then, when the runners are filled, it must be shoved ahead by the now fast-entering melt. This leads to flow marks, to local variations in properties, to inter-cavity differences in piece dimensions, and even to short shots.

It is important, therefore, that the melt reach all the gates at very nearly the same time.

Suppose now that this has been accomplished and that all the cavities begin to fill at the same time. But through differences in the dimensions of cavities, gates and/or runners, some are filled before others. Since in the moving melt most of the available pressure is expended in forcing the melt through the constricted gates, the pressure inside the first-filled cavities is rather low until all the others have filled and the full static melt pressure is brought to bear on all. By this time the first-filled gates may have sealed, but later-filled ones are packed at high pressure, and, when the mold is opened, these cavities will contain heavier—and therefore larger—pieces than the ones that sealed while the pressure was low. These may even be marred by sinks and voids.

In order to have the same shrinkage in all the cavities, and to have the parts with the same dimensions coming out of identical cavities, all the cavities should finish filling at the same time. (It should be plain from the discussion on Objective 1 that all the cavities must *start* filling at the same time if they are to consistently finish at the same time. Thus Objective 1 is not only important for the reasons given, but also for the attainment of Objective 2.)

Picture a mold in which all the cavities have filled at the same instant. Because some of them are further from the sprue than others, the mold designer made some of the gates larger than others. When the cavities are full the melt in these gates begins freezing progressively toward the centers. The heat of the melt moves by conduction through the chilled layers to the mold metal and, eventually, into the circulating coolant. Almost all of the drop in temperature from melt to coolant occurs in the frozen skin of plastic in the gate because plastics conduct heat much more slowly than do metals. Under such conditions, in a slit-type gate, it is known that it takes four times as long to seal a gate 40 mils deep as it does a gate of the same width and length but only 20 mils deep. The slow oozing of melt through the center of the gate during the packing stage does not change this ratio much. But the packing stage continues four times as long in the twice-as-thick gate. (If the gate thicknesses were in the ratio 1:3, the packing periods would be in the approximate ratio 1:9.) Again there would be cavity-to-cavity differences in shrinkages and dimensions of the molded pieces. Thus it is important to seal the gates at the same time, too.

Occasionally, as has already been noted, it is desirable to pack the cavities thoroughly after they have filled. As packing proceeds and the piece chills, colder and colder material is forced into the cavity. Very viscous material, already almost frozen, is sheared in the neighborhood of the gate. The associated high stresses are frozen into the finished piece, making it weak near the gate. The thicker the section, the less severe is the effect, and, fortunately, it is in the thick sections that packing is most needed to prevent sinks and voids that might occur as the sealed-in molding cools and shrinks in the cavity. In thin sections, where strength and toughness are wanted, packing does more harm than good (although it does reduce shrinkage), and it is best to seal the gates soon after filling. From the above discussion on heat transfer in gates it is clear that this means using shallow gates (which fits in with the desire to minimize finishing costs).

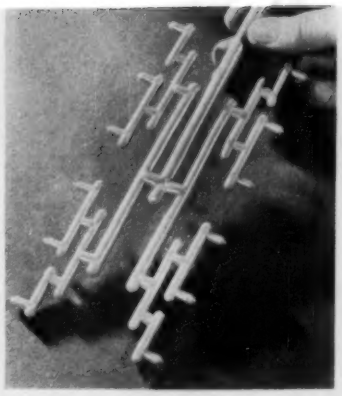


Fig. 4: Runner layout for 12-cavity mold approximates an OC layout

In the first published treatment of runner and gate design (Ref. 1), the author gave an empirical formula for "balanced gating," derived from observations of short shots in molds. It was simple in form, helped in dealing with the bugaboo of short shots, and stimulated a good deal of thinking on the subject. But it cannot achieve any of the three objectives of successive simultaneity—SS—and is bound to lead to difficulties where close control of dimensions and strength properties is wanted.

How SS is achieved

The pertinent equations for flow of plastic melts in channels of circular and rectangular cross section are: For circular channels,

$$Q = \frac{\pi f_0 D^{n+3} \Delta P^n}{2^{n+3} (n+3) L^n} \quad \text{Eq. 1}$$

For rectangular channels (4)

$$Q = \frac{f_0 w h^{n+2} \Delta P^n}{2^{n+1} (n+2) t^n} \quad \text{Eq. 2}$$

where

Q = the volume rate of flow through the channel, cu. in./sec.

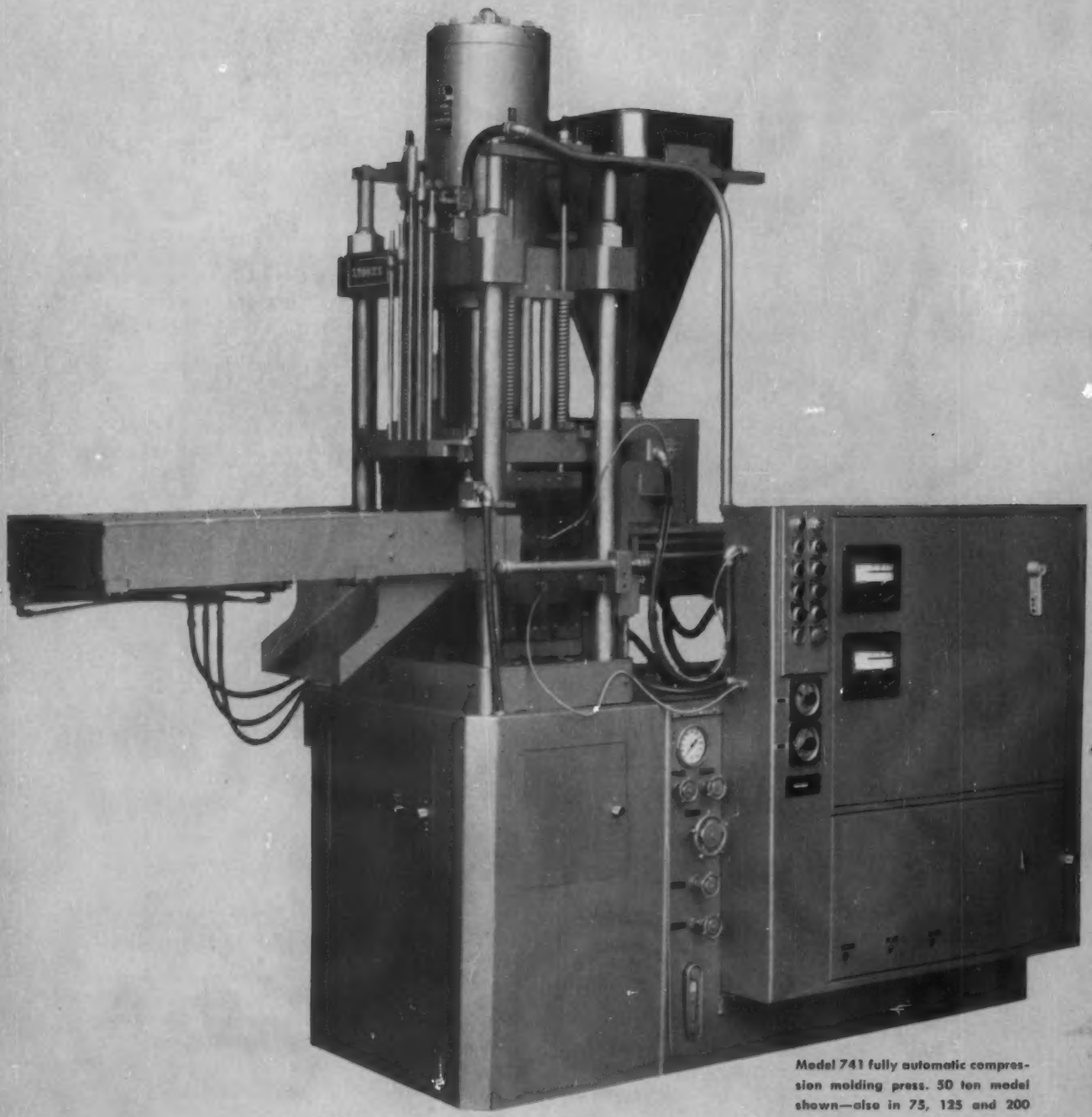
f_0 = a material flow property, the "generalized fluidity"; it[3] is

(*To page* 170)

[3]See Ref. 4 for a discussion of f_0.

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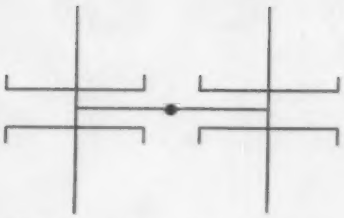


Fig. 5: An organization-chart runner layout for a 12-cavity mold

numerically equal to the shear rate in laminar flow at a shear stress of 1 p.s.i. Its unit is $(sec.)^{-1}$.

L or t = the length of the circular (L) or rectangular (t) channel in the direction of flow, in. In gates t is called the land length.

ΔP = the drop in pressure over the length of the channel, p.s.i.

D = the diameter of a circular channel, in.

h = the depth of a rectangular channel, in.

w = the width of the cross section of a rectangular channel, in. Equation 2 is based on an assumption that the width w is much greater than the depth. It applies with less than 15% error to channels where w is $4h$ or larger. Smaller values of w/h are not recommended (though the formula will serve satisfactorily if w/h is kept the same for all the gates) because w then becomes an important factor in the freeze-off time of the gate.

n = another material property, the "power law" exponent. The power law (1) is a modified Newton's law of laminar flow that says that the shear rate is proportional to the nth (rather than the 1st) power of the shear stress. This law holds over wide ranges of flow rate for many plastics (1, 2), and the values of n mostly range between 2.5 and 3.5.

The equations apply strictly to melts at constant temperature throughout the channel length. While this condition prevails closely in the gates, where the length is short and the melt is going through at relatively high speed, there is certainly some cooling in the runners, particularly after the runners have filled and the flow is slowed by the added resistance of the gates. The effect of this cooling is to reduce the effective diameter of the runners slightly, but the essential relationships are not changed. A perfectly rigorous design would have to take into account the complex effects on flow rates of heat transfer from the moving melt, of heat generation in the melt due to (unequally distributed) viscous working, and of cooling of the melt due to its slight expansion along the channel as the pressure falls, in addition to the non-Newtonianism of the melt. This problem has been examined; it cannot be solved by ordinary methods.[4]

The above equations apply over very short lengths of the runners, and, by a cumulative process, to their whole lengths. If all the runners have the same dimensions, are at the same temperature, and supply the same number of cavities, exactly the same states and rates should prevail at corresponding points in all of them. Identical runners, then, should result in the melt reaching all the gates at the same instant (Objective 1 of SS). Furthermore, even when they absorb a large share of the pressure drop, they should offer no obstacle to Objective 2. To obtain this correspondence between equivalent runners, the temperature of the mold must be uniform to within a few degrees F. over the whole runner system.

Identical cavities

The simplest and probably most common reason for multi-cavity molds is to obtain high production rates of a single item in identical cavities. In such a case, it is very worth while to design the runner system so that the path to each cavity is identical with the paths to all the others. When the number of cavities is an integral power of 2 (4, 8, 16, 32, 64, etc.), path identity is easily accomplished by an "organization-chart" runner network. In this network, the sprue is branched into two main streams; each of these is branched into two substreams; the substreams in turn are divided into two and the process is repeated until the number of streams is equal to the number of cavities.

Figures 1, 2, and 3, show three different ways in which a 16-cavity mold might be gated. Figure 1 is a diagram of a conventional runner layout, where the melt takes as much as 80 times as long to reach the most distant gate at it does to reach the nearest one![5] Figure 2 is a photo of an improved network in which the time factor has been reduced to about 3. Figure 3 shows one form of the "organization-chart" (OC) layout, which gets the melt to all the gates at the same instant. Note that the lengths of, and number of cavities served by, all corresponding branches, are the same for every cavity. Each stream has even gone through the same number of right-angle bends (not too important a detail in laminar flow). Note also that the total length of runners has been increased over that in Figs. 1 and 2. This can be offset (at a sacrifice in filling rate) by making the runners smaller, for, as was noted earlier, there is no desperate need for them to be large when they are identical. Finally, note that the OC layout did not involve any repositioning of the cavities.

To simplify the mounting and driving of knockout pins, the 2-row line-up of cavities, as in Fig. 2, seems to be very popular, though far from universal. This line-up has the disadvantage that it tends to concentrate the clamp-opening force along the center line of the mold. This in turn causes larger central deflection of

[4]Some idea of what must be done to solve even a simplified version of the problem, in which the channel wall is held at the temperature of the entering melt, can be gathered from Reference 5.

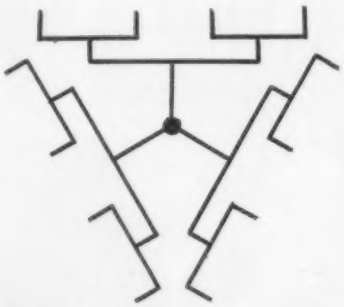
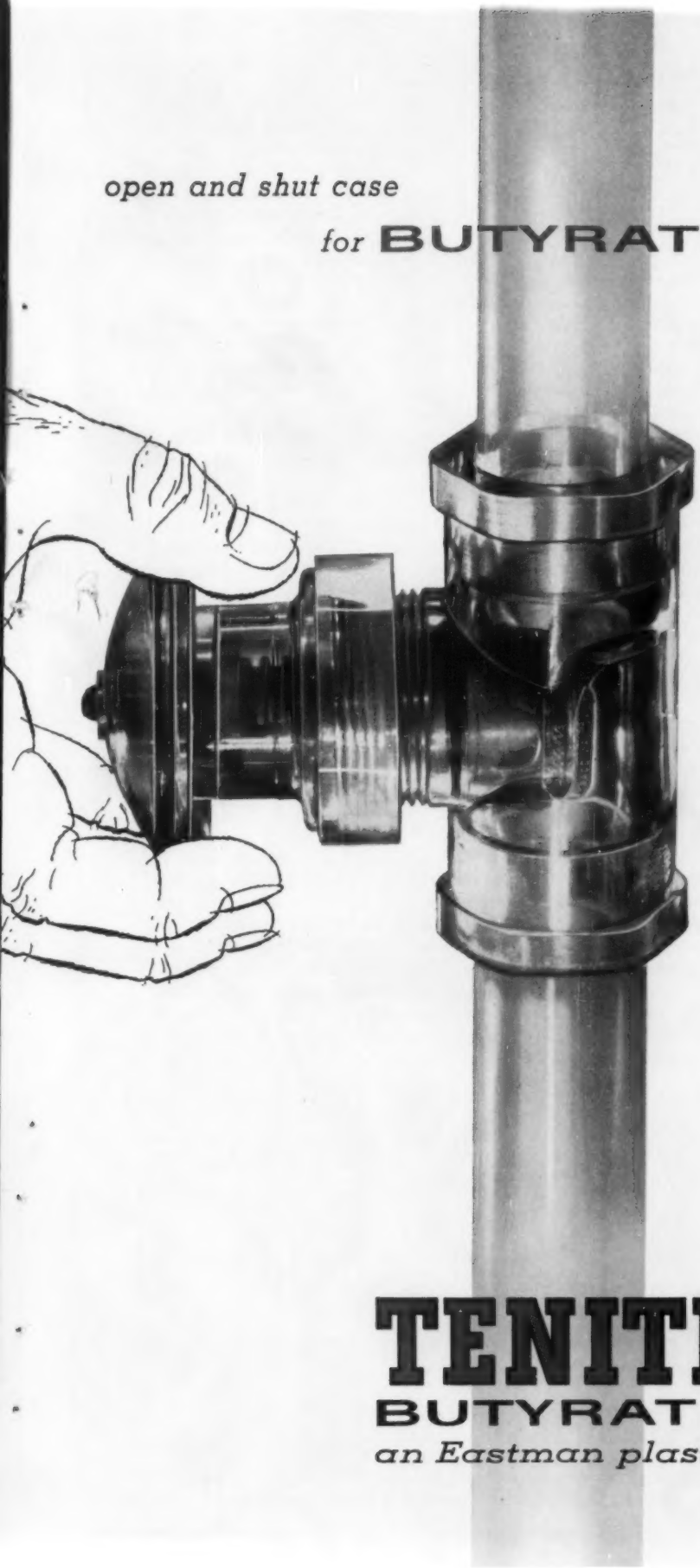


Fig. 6: Another way of accomplishing an OC layout for a 12-cavity mold

[5]See Eq. 4, footnote 6, p. 172.

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the mold under pressure, which gives rise to troubles with flash. As ejection mechanisms become more versatile, it will become simpler to apply the OC layout to numbers of cavities which are not powers of 2. However, such numbers can usually be handled even with a 2-row line-up. Figure 4, p. 167, is a photo of a runner network in which a very close approximation to an OC has been made with a 12-cavity mold. Here the path lengths are all the same but the number of cavities served by some of the outer branches differ by a factor of 2 for a very short distance. Practically speaking, this layout achieves SS. Where other considerations (knockout, cavity dimensions, and mold dimensions) permit, one of the layouts in Figs. 5 and 6 might be used for a 12-cavity mold. With a certain amount of ingenuity, almost any number of cavities can be accommodated in an OC layout or a sufficiently close approximation thereto. Figure 7 shows a satisfactory layout for a 10-cavity mold. It is important in making such layouts to locate the cavities symmetrically with respect to the mold center so that there will be no large unbalanced forces tending to open the mold more on one side than on the other.

Work closely with mold maker

If it is assumed in Eqs. 1 and 2 that $n = 3$ (a representative value, as good as any if the correct value is not known), these equations become

$$Q = \frac{\pi f_0 D^4 \Delta P^2}{3072 L^2} \qquad \text{Eq. 1A}$$

$$Q = \frac{f_0 wh^5 \Delta P^2}{80 t^2} \qquad \text{Eq. 2A}$$

With numerical exponents in the equations, it is immediately clear that small changes in D, h, L, and t will seriously alter the flow rate at a given pressure. As an example, consider two rectangular gates in a multi-cavity mold, each having a nominal depth h of 20 mils. A difference of only 1 mil in their actual depths, other factors being the same, would make a 21% difference in the flow rates (and in the filling times of identical cavities). Flow rates in the runners are even more sens.tive to variations in the runner diameter.[6] So it is vital to the attainment of SS that tolerances on the order of 1% for h, t, and D be set *and adhered to*. The wise thing to do is to make the tolerances part of the contract with the mold maker. Each runner should be checked at several points along its length and the lengths and depths of gates in particular should be carefully checked before the mold is run. The larger faces of the rectangular gate, the faces that are separated by the depth h, must be flat and parallel. The side faces of the rectangular gate are not so critical.

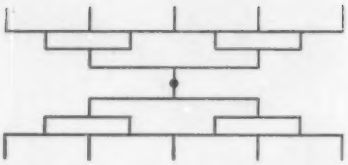


Fig. 7: Ten-cavity layout closely approaches SS with two-row line-up

A good deal of time and expense can be saved if the mold maker understands clearly that such tolerances are really needed and that they have to be met. In this connection, it is also important that the mold faces be amply supported so that they will not bend apart under the injection pressure. Over the width of the mold the deflection resulting from such bending is usually more serious in the center and diminishes toward the edges. This opens the gates nearer the center more than those away from the center, thereby setting up differences in filling time as well as sealing time.

Equations 1A and 2A also reveal that filling times are sensitive to slight differences in the available pressure head. From this point of view (as well as that of burning the plastic in fast-filled cavities), it is important that the cavities be vented well enough so that the air in them escapes easily as the cavities are filled with material.

Where the pressure is used up

Equations 1A and 2A give direct estimates of the drops in pressure over the runner and gate. The results are a little surprising; it is generally thought, because the gate is so much smaller in cross section, that the drop along the runner is small compared with that through the gate. The much greater length of the runner offsets the difference in cross sections. And this finding is in accord with experience: to get faster filling, gates usually have to be opened up considerably more than one would suspect from the great sensitivity to h indicated by Equation 2A. This can be so only if the pressure drop across the gates is a small part of the total.

A simple example will serve to illustrate the point. Consider a runner 10 in. long and 0.250 in. in diameter that feeds a single 3-cu. in. cavity through a gate with the dimensions h = 0.020, w = 0.080, and t = 0.080 inch. The diameter of this relatively short runner would be considered generous enough by most molders, and the gate is certainly a small one for the cavity. Therefore, it is logical to expect that a

(*To page* 292)

[6]Equation 1A was derived on the assumption that the channel length was a fixed quantity. In filling the runners, to the contrary, the length through which flow is occurring increases from zero at the start of the injection stroke to the total runner length when the melt hits the gate. In figuring the time needed to fill the runner system, therefore, Eq. 1 must be used in the differential form

$$Q = \frac{\pi f_0 D^{n+3}}{2^{n+3}(n+3)} \left(\frac{dP}{d\tau}\right)^n \qquad \text{Eq. 1B}$$

It is also known that at any point τ along the runner, corresponding to an elapsed time θ, the melt is advancing at the average rate given by

$$\frac{d\tau}{d\theta} = \frac{4Q}{\pi D^2} \qquad \text{Eq. 3}$$

Assuming that a steady melt pressure is available at the sprue as the runners fill, these equations can be combined and integrated with respect to τ and θ to get the runner-filling time, θ_f. For $n = 3$ the result is

$$\theta_f = \frac{192 t^4}{f_0 D^4 \Delta P^3} \qquad \text{Eq. 4}$$

Thus from the standpoint of SS, Objective 1 is sensitive to the 4th power of the runner diameter. (For simplicity the changes in melt temperature during runner filling and the related factors have been ignored here as before. Taking them into account would not greatly change the exponent of D, but would very likely increase the exponent of the length t.)

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By supplying uniform heat to large surfaces, the blanket is cutting production times in laminating to fractions of what they were. A furniture maker is drying glued plywood lay-ups in one-seventh his former time by putting the blanket right into his press with the laminate (Fig. 1). The blanket will withstand pressures up to 200 p.s.i. A plastics laminator suspends his blankets in metal frames sealed along their edges. The hot blanket is sucked down onto the laminate by vacuum and hugs even the hollows and humps in the laminate surface. In laminating plastics to table tops, sink tops, and the like, the blanket is outstanding for edge work, cutting laminating time from hours to minutes (Fig. 2). It is available in narrow strip form as well as "blanket" width (Fig. 3).

The blanket finds use in almost any application where heat must be applied evenly to a surface, providing only that it is not necessary to reach temperatures above 220° F. or pressures over 200 p.s.i. Wet silk-screen print on wallpaper is dried continuously by pulling the printed paper over a blanket as it comes off the press. Fast drying of print is even more of a problem on plastic webs, (see MODERN PLASTICS, *33*, 120, March 1956), which generally do not absorb ink vehicles but must dry by evaporation. The blanket should be useful here, too. Faster drying is possible with thin webs because of the direct contact of the web with the heat source.

In many plastics laminating operations, the blanket may well eliminate the need to heat platens of laminating presses. Also, by using the blanket under air pressure or vacuum as one half of a forming mold, mold costs can be cut. Waterproof, resistant to many chemicals and to abrasion, it should be able to stand the gaff of plastics processing. If punctured, the hole can be ignored or cut to a clean edge and sealed with an insulating mastic furnished by the blanket's maker.

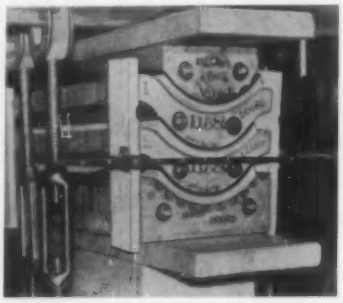


Fig. 1: Glue lines for bent-plywood lay-ups are shown being heat-cured under pressure with heating blankets. The glue lines are visible as black layers between platens and lay-ups. (Photos, U.S. Rubber Co.)

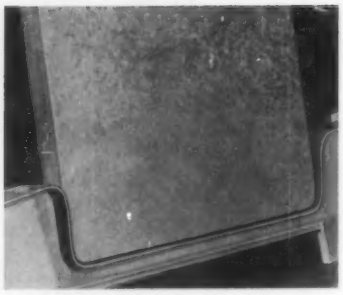


Fig. 2: Edge of table top being laminated in a jig under heat, supplied by narrow heating blanket, and pressure. With this method, entire operation requires 6 min.; it previously took 8 to 10 hours



Fig. 3: Laminator in furniture plant chooses a Uskon heating blanket as first step in applying a French cherry veneer to the circular edge of a lamp table. The wide variety of sizes in which these blankets are available is evidenced by the assortment in the bins



of thesis work is seldom predict-

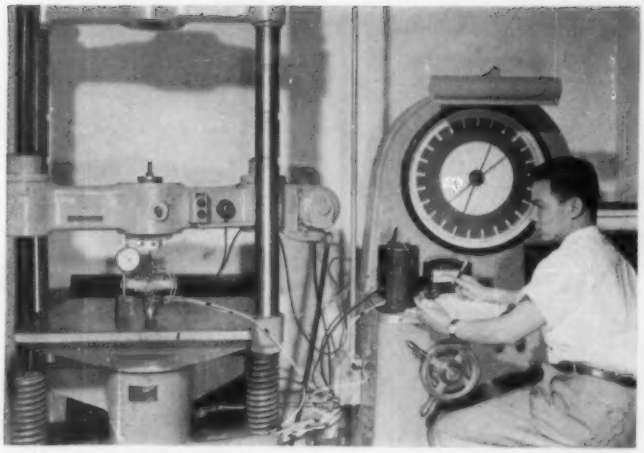


Fig. 1: Testing machine, a gift from Boonton Molding Co., applies forces to polymers by means of opposed pistons. Flow properties and melt compressibilities can be measured at pressures to 22,000 p.s.i. and temperatures from 70 to 350° F. Such data are fundamental to understanding what happens in molding and extrusion machines and essential to their proper design. (All photos, Princeton)



Plastics Program staff at the laboratory entrance (l. to r.): J. C. Elgin (dean), A. V. Tobolsky, R. N. Work, L. F. Rahm, D. S. Trifan, and B. Maxwell

Plastics engineering at Princeton

Unparalleled Plastics Program produces research-trained engineers

In 1947, the Plastics Program at Princeton University awarded the degree of Master of Science in Engineering to its first four graduates. Since then 33 more men have completed the world's only graduate-level program in plastics engineering. The complete Plastics Program also includes two undergraduate elective courses and offers Ph.D. candidates in chemical and mechanical engineering the opportunity of doing their research in plastics. The first such Ph.D. (in Ch.E. Dept.), should graduate in 1957.

Before the program was established it had been recognized that plastics were different from the older and better known engineering materials. Some creep rapidly under load, even at room temperature, and the mechanical properties of almost all plastics are significantly altered by changes of temperature in the usual use range. Whereas metals, concrete, etc., recover almost instantly from deformation when the deforming load is removed, plastics may recover slowly or perhaps not at all. Some plastics seemed to have some very attractive electrical



Viscometer being lifted from the constant-temperature bath is being used to measure the viscosity of a polystyrene solution. This property is a measure of the molecular weight of the polymer, in this case an important clue in a chain-transfer study

properties, particularly for the then burgeoning high-frequency applications.

Perliminary surveys of industry and education showed a fast-growing need for men qualified to work with plastics and at the same time revealed a dearth of educational facilities to train such men. The Plastics Program at Princeton, a cooperative venture of the Mechanical, Electrical and Chemical Engineering Departments and the Department of Chemistry, was devised to fill this urgent need. The program is very similar to those proposed by both the S.P.I. and the S.P.E. committees on education in plastics engineering.[1]

Objectives of the program

The primary aim of the Program is to educate men, through instruction and research, in the basic principles of the application, properties, processing, and fabrication of high polymeric engineering materials. Since plastics processing technology quickly becomes outdated, fundamentals rather than techniques are emphasized, and in the laboratory the students are taught only those elements of know-how that have lasting value.

The M.S.E. program includes five advanced courses and thesis study. Prerequisites are an undergraduate degree in engineering, chemistry, or physics, including the two undergraduate courses Plastics Technology and Plastics Laboratory or the equivalent.

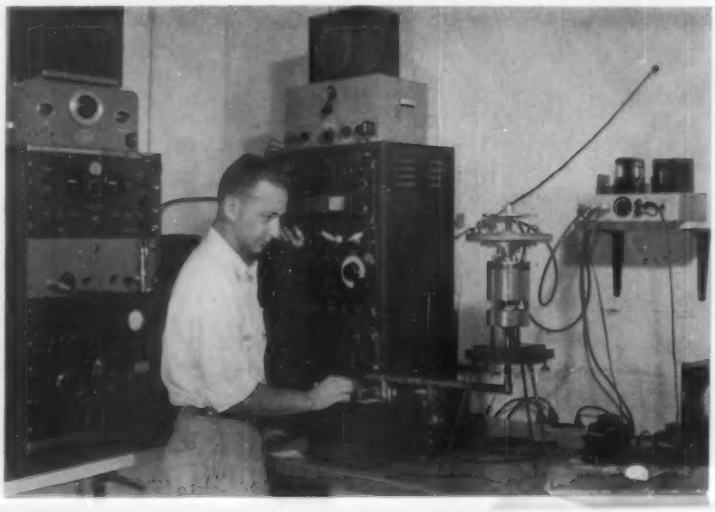
Thus a candidate entering with no previous work in plastics will take seven courses that total 21 credit hours. In addition, candidates having no training in certain fields must complete other prerequisites to some of the advanced courses. A candidate who has completed all the prerequisites except Plastics Laboratory may now earn his M.S.E. in a year, although most of the 37 graduates to date have taken two years to complete the work. Aside from the fact that the progress of thesis work is seldom predictable, it is a rare candidate who has completed all of the wide-ranging prerequisites in his undergraduate years. Likeliest candidate for 1-yr. completion are chemical engineers who have had courses in strength of materials and electronic circuits. Table I, p. 178, gives brief descriptions of the plastics courses and lists the required undergraduate preparation.

The staff

The heart of any university curriculum is the men who teach it and guide the research. The six members of the Plastics Program faculty are widely respected for their valuable contributions to our knowledge of the behavior, manufacture, and molding of polymers, and to the literature of these fields. They are: Professors J. C. Elgin and L. F. Rahm, Associate Professor A. V. Tobolsky, and Assistant Professors B. Maxwell, D. S. Trifan, and R. N. Work. Prof. Rahm is Director of the Plastics Laboratory, where most of the work of the Program is carried out. An advisory council —15 of the most forward-looking men of the plastics industry— keeps the faculty informed on the needs of the industry (and vice versa) and makes suggestions on the objectives, course material, and laboratory equipment.

Unlike graduate students in general, students of the Program get a great deal of individual at-

Highly sensitive apparatus is being used to determine the dielectric constant and electrical loss factor of a model styrene copolymer. These properties are a measure of the forces acting among and within the polymer chains, which in turn provide insight into the relationship between properties and structure



[1]See, for example, "S.P.E. Program for Engineering Education in Plastics" by the National Education Committee of the S.P.E., 1955.

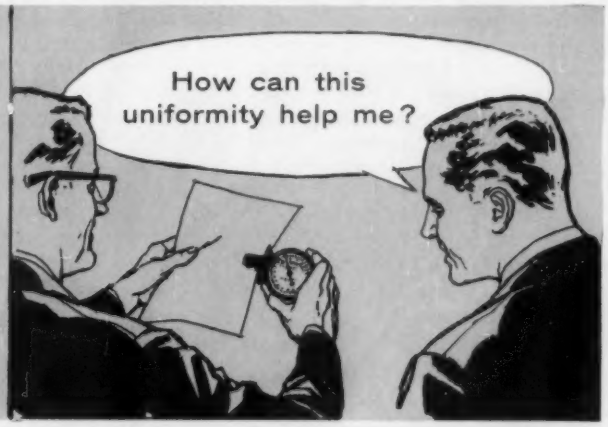
A plastics processor learns the profit story about special-purpose papers



1 Yes. These are just a few of thousands of products plastics firms make using Mosinee resin-impregnating paper as the matrix for producing counter and table tops and decorative plastic panels. Other uses include durable plastic siding and facing for new and remodeled buildings.



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Table I: Courses of instruction in the Princeton Plastisc Program[a]

M.E. 529 Mechanical Properties of Plastics—3 hr. lect. per week.
Evaluation of plastics; theory of rheological behavior; examination of testing techniques, equipment and A.S.T.M. Standards. Correlation of composition and structure of plastics with engineering properties. Study of effects of various types of loading and environment on elastic and plastic behavior of materials.

Prerequisites: Mechanics 205 or equivalent;
Plastics Technology 427 or equivalent (may be concurrent)

M.E. 520 Plastics Product and Equipment Design—2 hr. lect., 3 lab. hr. per week.
Selection and specification of materials; design of components considering methods of fabrication; engineering application of plastics; design of fabricating equipment.

Prerequisites: Mechanical Properties of Plastics 529;
Plastics Laboratory 428 (may be concurrent)

P.E. 518 Dielectric Properties and Measurements—3 hr. lect. per week.
Theory of the static dielectric constant and internal field, dielectric relaxation, conduction and breakdown and relation to microstructure and insulating properties of polymers. Theory and techniques of measuring resistivity, dielectric strength, arc resistance, and the dielectric constant and loss factor over a wide frequency range for evaluation of materials for engineering applications.

Prerequisites: Electronic Tubes and Circuits 316A or equivalent

Ch.E. 546 Chem. Eng. of High Polymers—3 hr. lect. per week.
Analytical study of the chemical engineering and physico-chemical principles underlying the industrial scale manufacture of the more important types of high polymeric materials. Raw materials and industrial processes for selected plastics, elastomers, thermoplastics and thermosetting resins from the viewpoint of the basic unit operations and unit processes involved. Addition, condensation, and emulsion polymerization. Principles involved in equipment design for these processes.

Prerequisites: Elem. of Ch.E. 343 or equivalent;
High Polymer Chem. 513 or equivalent (may be concurrent)

Chem. 513 High Polymer Chemistry—3 hr. lect. per week.
Mechanism and kinetics of condensation and addition polymerization; molecular weight distribution; size and structure of macromolecules; chemistry and technology of rubbers and plastics and relation between structure and properties; theory of visco-elastic behavior, physical chemistry of natural polymers and derivatives; theory of high polymers solutions and three-dimensional polymers.

Prerequisite: Organic Chemistry 304A or equivalent

M.E. 427 Plastics Technology—3 hr. lect. per week.
History, composition, production and properties of plastics; molded, cast and laminated products, adhesives, films, filaments and textiles; fabricating processes, molds, presses, molding cycles, accessory equipment, plant equipment, engineering design, finishing and inspection methods.

NOTE: *An introductory undergraduate course, required of candidates in the plastics program as prerequisite to, or concurrent with Properties of Plastics 529.*

M.E. 428 Plastics Laboratory—2 hr. lect., 3 lab. hr. per week.
Lectures and Laboratory study of conversion of polymeric-materials to finished products; compression-, transfer-, injection-molding, extrusion, calendering, milling and blending, laminating, and production of resins. Effect of fabrication variables on production and properties of product. Testing of mechanical, electrical, and miscellaneous properties of plastics.

Prerequisites: Mechanics 205 or equivalent;
Plastics Technology 427 or equivalent

NOTE: *An introductory undergraduate course required of candidates in the plastics program as prerequisite to, or concurrent with Plastics Design 520.*

[a]Information taken from booklet, "Princeton University Plastics Program," published by Princeton.

tention from the Laboratory staff, whose principal responsibilities are to the Plastics Program. With only a few undergraduate courses to handle, they can devote their main attentions to the graduate course and guidance of research. About four men have graduated per year, and, since the work generally takes two years, the usual complement of graduate students has been about 8. While this number is expected to increase in the future, students can expect to enjoy a close working relationship with the Program's six-man staff.

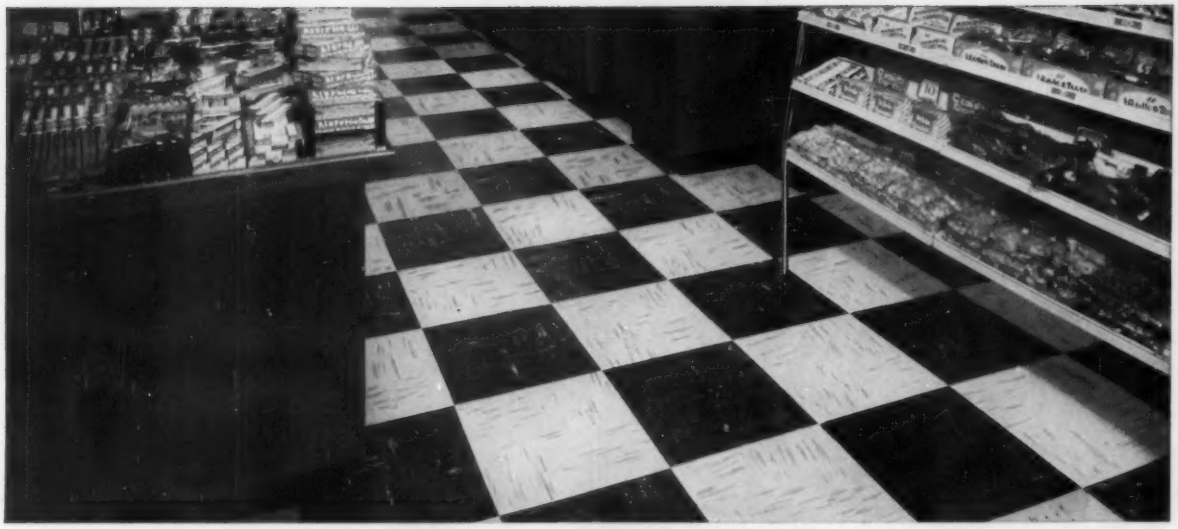
Research program

An extensive program of research is being carried on with the support of the Armed Services. This work was originally begun to obtain new or improved materials for military uses, and in the early days many such materials were developed. Since then the emphasis has shifted to fundamental studies in principles and methods; such studies are better suited to developing research talent and making important contributions to the science underlying plastics technology. Of course, publishability of results is important and so far none of the Services-sponsored work has been classified. From the standpoint of the industrial designer, who desperately needs reliable data on the behavior of a long list of plastics, it is a pity that the necessary emphasis on principles and methods prevents anyone at the Laboratory from widely applying these methods and doing the "routine" work of collecting data on more than a few of the important plastics.[2]

On the other hand, the scope of the research work has been startlingly broad, in view of the small size of the entire group to date. While the primary attention of the Program is focused on plastics, all polymers, whether natural or synthetic, fibrous, resinous, or

(*To page* 183)

[2]For example, under Prof. Maxwell's direction, equipment was developed for measuring the tensile stress-strain response of plastics over wide ranges of temperature and rate of loading. However, it is not within the objectives of the Laboratory's research program to obtain such detailed measurements on more than a few materials. The situation points up the need for an institute that would serve the plastics industry in grinding out some of these "routine" data that are so important to reliable design of load-bearing plastics products.



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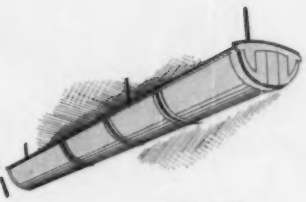


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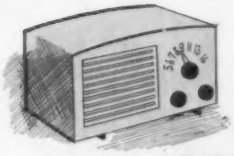


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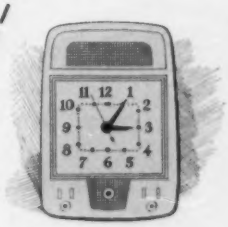
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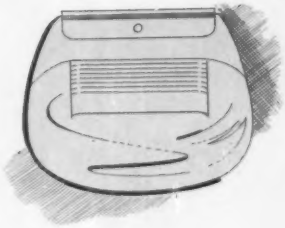
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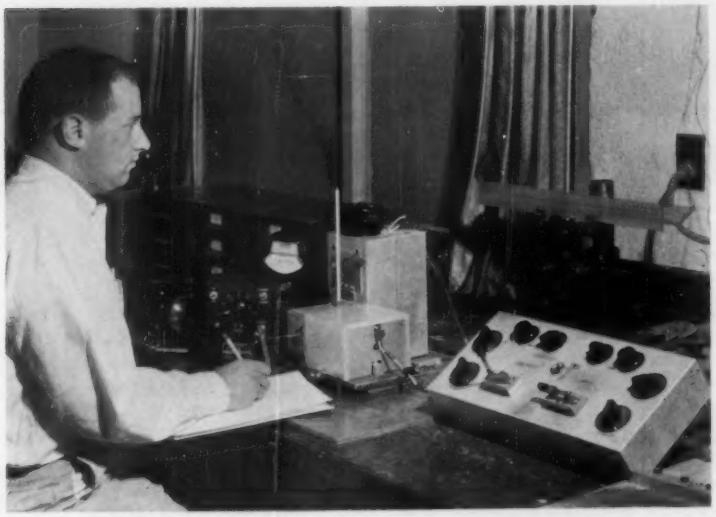
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elastomeric, are fair targets for study. Much of the work falls into three classes: chemical, electrical, and mechanical, and three groups have been set up to pursue these lines of research. The chemical section, under Prof. Trifan's direction, involves over half the total staff. Its members have contributed new materials to the Services and have made theoretical studies in high-polymer science.



Graduate researcher measures dynamic properties of a plastic at frequencies up to 800 c.p.s. Wide temperature range is possible. Mechanical loss factor (important in fatigue failure) is measure of rate at which heat is generated in material under cyclic load

Recent research includes work on the comparative structure and properties of polyurethanes and polyamides, chain transfer studies, and investigation of ferrocene compounds as possible components of a new group of polymers.

Prof. Work heads up the electrical section, which has investigated the nature of arc resistance and contributed to the techniques of measuring dielectric constant and loss factor of polymers. Loss factor studies are now being used to investigate the motion of polymer segments in families of polymers in order to establish the influence of structural configuration on electrical and mechanical properties.

Professor Maxwell's mechanical section has also made a basic analysis of the mechanism of crazing in polystyrene, as well as a study of the time and temperature dependence of mechanical properties. A new method of dynamic testing (see Fig. 1, p. 175) is now producing data on frequency- and temperature-dependence of the components of Young's modulus in plastics.

Some 50 projects have been attacked along these three main lines. Titles of the technical reports on a few of these projects, listed below, give some idea of the scope of the research work:

The rheological properties of polystyrene below 80° C.

Preparation and vulcanization of liquid polyisoprene polymers

Low-loss, arc-resistant paper laminates

Mechanical properties of oriented polystyrene

Castor-oil polyurethanes and applications as potting compounds

Calculation of bulk viscosity of polyisobutylene from stress-relaxation data

The tensile impact properties of some plastics

A three-terminal dielectric test cell

Monoradical and diradical polymerization of styrene

An investigation of the torsional properties of plastics

While thesis projects so far have included no work on the thermal properties of plastics and very little on processing studies, such work is open to interested students.

The Laboratory

The Plastics Laboratory is a long, one-story building with offices, a conference room, a processing and fabricating laboratory, considerable chemistry laboratory space, a constant-environment room, a mechanical properties laboratory, and electrical laboratories. The processing laboratory has been equipped largely through gifts from friends in industry who are sharply aware of the need for trained plastics engineers. There are compression and transfer presses, two small screw extruders, an injection molding machine, a sigma-blade mixer, a 10-gal. agitated polymerization autoclave, and a variety of machine tools. Emphasis is placed on thorough instrumentation that measures the state of the material while in process as well as machine conditions, and on the greatest possible flexibility and versatility.

At the last meeting of the Advisory Council it was agreed that the laboratory needs dielectric preheating and sealing equipment, vacuum forming equipment, and film making equipment.

Fellowships and research assistantships are available to the students.[a] While most of the research is done under contract to the Armed Services, a very liberal policy makes it possible for students and staff to work on almost any worthwhile project.

Graduates are in demand

A recent survey showed that 98% of companies in the industry need plastics engineers and have been forced to give them expensive on-the-job training. About three-fourths preferred, at the Master's Degree level, men with the degree in plastics engineering over straight engineering graduates. In 40 companies it was estimated that over 1200 of their employees would be more

[a]Grants in aid or Fellowships are currently being sponsored by the following: American Cyanamid Co., Celanese Corp. of America, Du Pont Co. (Polychemicals Dept.), Goodall Rubber Co., Owens-Illinois Co., Phillips Petroleum Co., and Union Carbide and Carbon Corp.

useful to them with plastics engineering training, and 75 new graduates per year could be absorbed, even without allowing for expansion. The total industry requirements might be four or five times this number. It is clear that graduates of the Plastics Program may expect a seller's market for their services for a long time to come. And it is clear, also, that graduates from the Princeton Program alone can only partly supply the demand.

What are the graduates doing?

About one-fifth of the graduates are working in research, another fifth in production, two-fifths in development and design, about ten percent in technical service, and the rest in other jobs. When the industry was questionnaired as to where Plastics Program graduates would be placed, the distribution in 275 replies came very close to these actual records of placement. Since the terms "development and design" cover a wide range of possible duties, it would have been interesting to have made a closer scrutiny of the duties of this group, which constitutes almost half of the men. It seems possible, at least, that many of the men working in "design" are designing equipment and processes for the handling and shaping of plastics rather than designing plastics products.

What's ahead

If the present course has any weakness, it is that aspects important to product design are given approximately 7 hr. in the graduate Program, while those important to plastics processing are given perhaps 2 credit hours (see course descriptions in Table I, p. 178). This unbalanced emphasis is also reflected in the titles of the Research Reports, of which only 10% deal with factors important in molding, extrusion, sheet forming, and welding of plastics. (However, the new rheometer of Fig. 1, p. 175, promises to shed new light on plastics behavior under processing conditions.) It is inevitable that as plastics processing becomes a more competitive business, the need for men who can apply engineering principles and analytical methods to problems of processing and equipment design and operation will be felt keenly. It is also inevitable that as plastics gain wider recognition as materials for engineering uses, the engineering student will find them included in his courses on materials of construction at engineering schools everywhere. On the other hand, it is unlikely for a long time to come that courses in plastics processing will be offered by more than a few engineering schools: equipment is too costly to buy and to run.

Thus it can be expected that the average engineering graduate of the future will have the training needed to handle intelligently many problems in the application of plastics, but will know little more about plastics processing than he does today. Eventually the changing needs of the industry will be reflected by a swing in emphasis toward plastics processing in the Princeton Program (and in programs that may develop elsewhere[4]). This change will be encouraged by the already growing body of published results of research on plastics processing, a respectable amount of which has appeared since the Program was established. But no matter how the needs of the plastics industry may change, it is to be expected that, under the guidance of the Advisory Council, the Plastics Program at Princeton will respond to those needs.

[4]It is interesting to note that the 3-year certificate program in plastics engineering given at the Newark College of Engineering, though taught at a considerably simpler technical level, gives a much greater share of the instruction to processing and processing machinery.

One corner of processing lab. Student is running horizontal injection machine, behind him is a vertical injection machine. At extreme left is 1.5-in. extruder with separate oil heater. To right is resin kettle. In right foreground is two-roll compounding mill



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Dr. Gordon M. Kline, Technical Editor

Polysulfide-epoxy compositions

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By E. H. Sorg† *and C. A. McBurney*†

Copolymerization of epoxy resins with thiol-terminated liquid polysulfide polymer results in permanently flexibilized materials which possess unique properties for protective coatings and adhesives. The chemically combined polysulfide enhances cure characteristics, wetting, adhesion, flexibility, and impact and thermal shock resistance in these products.

Variation of the liquid polymer-epoxy resin ratio, type of epoxy resin, and type and concentration of amine produces coating and adhesive compounds with diverse properties. Very flexible and impact-resistant coatings possessing the chemical resistance of baked films can be obtained in one coating applied at 75 to 85% solids and room temperature cured. Adaptability to hot spraying at 100% solids should extend the applications for these coatings. Adhesives possessing improved bond strengths with room and elevated temperature cures are obtained. The markedly improved peel and bend strength and high resistance of the polysulfide-modified epoxy adhesives to chemicals and solvents, thermal shock, and impact suggest possible new applications for the epoxy resins. Reduced strength at temperatures exceeding 160°F. is a disadvantageous characteristic of polysulfide-epoxy adhesives. However, by proper compounding good bond strengths can be obtained at temperatures of 180 and 250°F.

The epoxy resins are a recent addition to the list of commercial polymeric materials available for preparation of protective coatings and adhesives. These resins constitute a new class of condensation polymers and thanks to their structure and inherent properties are particularly adaptable for these applications. Thiol-terminated liquid polysulfide polymers have been used extensively during the past decade for the preparation of potting, adhesive, sealant, and coating compositions. They co-react with epoxy resins in the presence of an organic amine at room and elevated temperatures to give materials possessing a number of improved properties over either polymer when converted alone. The elastomeric polysulfide segments in the epoxy chain impart permanent flexibility, reduce internal strains during conversion, and, at the same time enhance wetting properties of the polysulfide-epoxy composition.

Basic structure of polymers

Thiol-terminated liquid polysulfide polymer chains are saturated and relatively linear with some branching. One-half and 2 mole percent trichloropropane are used for crosslinking (1)[1]. Their average structure is represented in Formula 1, p. 188, where n = 26 for LP-2, 6 for LP-3, 3 to 4 for LP-8.

High-molecular-weight, elastomeric polysulfide polymers possess excellent solvent, oil, and weathering resistance and low temperature properties. Pertinent properties of the polymers are given in Table I, p. 188 (2).

The proposed chemical structure of the epoxy resins prepared by the condensation polymerization of bis-phenol A and epichlorohydrin is illustrated in Formula 2, p. 188 (3).

Basically they are linear poly-

*Reg. U.S. Pat. Off.
†Thiokol Chemical Corp.
The authors are grateful to the members of the Technical Service and Research Departments for their assistance and to the Navy Department, Bureau of Aeronautics, for permission to use technical information in the publication of this paper.
[1]Numbers in parentheses link to references at end of article, p. 294.

Table I: Properties of commercial liquid polysulfide polymers

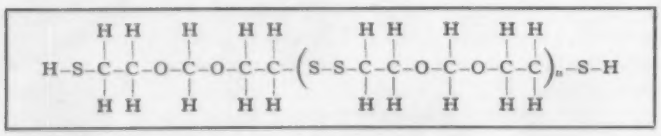
	Polymer LP-2[a]	*Polymer LP-3*[a]
Physical state at room temp.	Mobile liquid	Mobile liquid
Color	Clear, amber	Clear, amber
Viscosity at 25° C., poises	350-450	7-12
Average molecular weight (approx.)	4000	1000
Specific gravity, 20°/4° C.	1.27	1.27
Refractive index, n_D^{28}	1.5689	1.5649
Pour point, °F.	35	—15
Flash point (open cup), °F.	450	418
Fire point (open cup), °F.	475	465
Moisture content, %	0.2 max.	0.1 max.
pH (water extract)	6.0-8.0	6.0-8.0
Composition, mole %		
Bis(2-chloroethyl) formal	98	98
Trichloropropane	2	2

[a]Manufactured by Thiokol Chemical Corp.

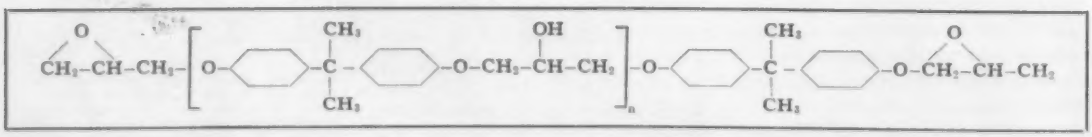
Table II: Physical properties of commercial epoxy resins

Epoxy resin	*Physical state at room temp.*	*Melting point*[a]	*Viscosity*[b] *(Gardner-Holt)*	*Epoxide equivalent*[c]
		°C.		
Epon[d] 828	Viscous liquid	8-12	Z_5-Z_6+	190-210
Epon 1001	Solid	53-76	C-G	450-525
Epon 1004	Solid	95-105	Q-U	870-1025
Epon 1007	Solid	127-133	Y-Z_1	1550-2000
Araldite[e] CN-501	Solid	55-61	D-E	385-445
Araldite CN-5001	Solid	80-92	J-M	620-770
Araldite KD-339	Solid	115-130	Z_2-Z_4	1150-1450
Araldite CN-503	Viscous liquid	—	Z_6-Z_7	205-235
Araldite CN-504	Liquid	—	T-V	240-270
Epiphen[f] ER-823	Very viscous liquid	—	Z_7+	220
Bakelite[g] BR-18794	Viscous liquid	—	Z_4-Z_5	185-200

[a]Durrans' mercury method.
[b]Epon 828, Araldites CN-503 and CN-504, Epiphen ER-823, and Bakelite BR-18794 on solid resin; all other types on 40% (by weight) solution in butyl Carbitol at 25°C.
[c]Grams of resin containing 1 gram-equivalent of epoxide.
[d]Manufactured by Shell Chemical Co.
[e]Manufactured by Ciba Co.
[f]Manufactured by The Borden Co., Chemical Div.
[g]Manufactured by Bakelite Co., a Division of Union Carbide and Carbon Co.



Formula 1



Formula 2

ether chains with reactive hydroxyl groups, spaced at intervals, and epoxide end groups. The ether linkage possesses good chemical resistance and the highly polar characteristics of the resins impart excellent adhesion properties in protective coatings and adhesives. Properties of commercial epoxy resins and their manufacturers are listed in Table II, left (4).

Liquid polysulfide polymers copolymerize with epoxy resins primarily through an addition reaction involving the mercaptan terminals and epoxide end groups (5). Since both polymers are polyfunctional, high-molecular-weight cross-linked resins containing elastomeric polysulfide segments are obtained. The generalized reaction is believed to proceed as shown in Formula 3, p. 189.

There are no by-products formed and the maximum volume shrinkage ranges from 2 to 4% during conversion. Although the reaction will proceed at room temperature, it is too slow to be practical, and useful products are not obtained. Relatively strong organic amines, such as diethylenetriamine, triethylenetetramine and tri-(dimethylaminomethyl) phenol (DMP-30[z]) are used to facilitate reaction. The polymerization is exothermic and proceeds readily at room temperature.

Extraction tests in boiling tolu-

[z]Manufactured by Rohm & Haas Co.

Table III: Cure schedule for polysulfide/liquid-solid epoxy coatings

Time	*Temperature*
	°F.
3 days	60 to 90
30 min.	150
15 min.	200
5 min.	250
4 min.	300
3 min.	350



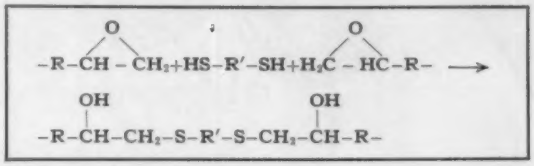
brush, roller coating, and trowel

ene have demonstrated that the polysulfide polymer co-reacts with the epoxy resin and acts as a chemically bound flexibilizer (5). Coating and adhesive compositions with a wide range of properties can be prepared by simply varying the liquid polymer/epoxy resin ratio, type of epoxy resin, and type and concentration of amine.

Coating compositions

Protective coatings possessing versatility of application, curing characteristics, and film properties are obtainable with epoxy resin compositions modified with liquid polysulfide polymer. The coatings can be deposited at 75 to 85% solids with conventional spray equipment to give films, with a range of thickness for one coat application, that exhibit good adhesion to superficially cleaned surfaces. This property is a major application advantage of these coatings over conventional types of commercial coatings and should be sufficient to offset their higher raw material costs. Thin or heavy films possessing similar properties to baked finishes are readily obtainable with room temperature cures. The coatings develop excellent adhesion, flexibility, sanding and rubbing properties, impact and scratch resistance, and high gloss.

Formulation: Protective coatings modified with liquid polysulfide polymer have been prepared with liquid epoxy resins, solid (high-molecular-weight) epoxy resins, and liquid-solid epoxy resin blends. Investigation of these coating systems disclosed that the polysulfide/liquid-solid epoxy blend systems possess the best balance of properties for coatings. At the present time these coatings are prepared as a two-package mix. One part contains the liquid-solid epoxy blend and the other part the liquid polysulfide polymer and organic amine. The liquid-solid epoxy blend is prepared by heating the polymers at the melting point of the solid epoxy resin until solvation is complete. Due to the high viscosity of the liquid-solid epoxy blends, they must be cut with a suitable solvent for mixing with the polysulfide polymer to permit room temperature application with conventional spray equipment. The solvent thinning can be accomplished either when the epoxy blend is warm and fluid or after it has cooled to room temperature. Coating compositions suitable for



Formula 3

Table IV: Typical liquid polysulfide polymer/liquid-solid epoxy coatings

Components	Coating T-140-1 Part A	Coating T-140-1 Part B	Coating T-140-2 Part A	Coating T-140-2 Part B	Coating T-140-3 Part A	Coating T-140-3 Part B
LP-3	100	—	100	—	100	—
Epon blend No. 1[a]	—	200	—	—	—	—
Araldite blend[b]	—	—	—	200	—	—
Epon blend No. 2[c]	—	—	—	—	—	200
Beetle 216-8[d]	—	18	—	18	—	18
DMP-30	20	—	20	—	20	—
Methyl ethyl ketone	23	68	13	48	23	28
Part A/part B ratio	1/2		1/2		1/1.75	

[a]Epon 828/Epon 1007, 60/40 parts by weight.
[b]Araldite CN-503/Araldite CN-5001, 60/40 parts by weight.
[c]Epon 828/Epon 1001, 60/40 parts by weight.
[d]Urea-formaldehyde solution (American Cyanamid Co.) of 60% solids used to improve leveling.

Table V: Properties of polysulfide-modified liquid-solid epoxy blend coatings

	Coating T-140-1	Coating T-140-2	Coating T-140-3
Working properties			
Solids content, %	77	82	85
Spraying pot life, hr.	3	4	5
Curing characteristics at room temperature			
Set time, min.	30 to 40	60 to 70	95 to 110
Tack free time, hr.	1	2.5	3
Cure time			
To handle, hr.	2 to 3	4	5
Optimum cure, days	3	3	3
Physical properties			
Flexibility			
0.125-in. rod	Unaffected	Unaffected	Unaffected
Conical mandrel, % elongation[a]	35	34	32
Impact resistance, in.-lb.	>48	>48	>48
Adhesion	Excellent	Excellent	Good
Scratch resistance	Good	Good	Good
Clarity	Poor	Good	Good
Exterior weathering resistance[b]	Good	Good	Good

[a]After 8 mo. aging
[b]After 4 mo. exposure, tests continuing.

Look for

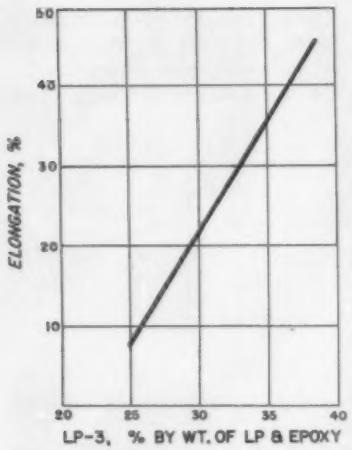


Fig. 1: Effect of polysulfide polymer on percent elongation of typical liquid-solid epoxy coatings

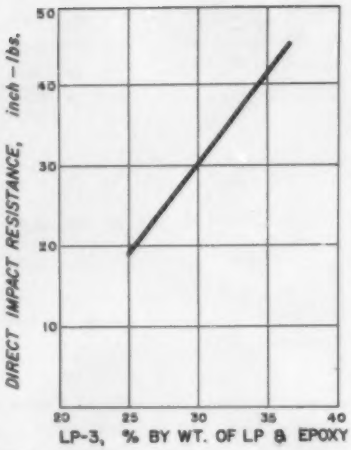


Fig. 2: Effect of polysulfide polymer on impact resistance of typical liquid-solid epoxy coatings

Table VI: Chemical and solvent resistance of polysulfide-modified liquid-solid epoxy blend coating T-140-1

Chemical or solvent	*Condition[a] of coating after exposure time*			
	1 day	*1 week*	*1 month*	*2 months*
Inorganic				
Hydrochloric acid, 10% by wt.	U	U	U	U
Hydrochloric acid, 50% by wt.	U	U	U	U
Sulfuric acid, 10% by wt.	U	U	U	U
Sulfuric acid, 50% by wt.	U	U	BL	F
Nitric acid, 10% by wt.	U	U	U	U
Nitric acid, 50% by wt.	BL	BL	F	—
Sodium hydroxide, satd. soln.	U	U	U	U
Aluminum hydroxide, satd. soln.	U	U	U	U
Sodium carbonate, satd. soln.	U	U	U	U
Aluminum sulfate, satd. soln.	U	U	U	U
Organic				
Acetic acid, 10% by wt.	U	BL	F	—
Acetic acid, 50% by wt.	BL	F	—	—
Citric acid, 10% by wt.	U	U	U	U
Citric acid, 50% by wt.	U	U	U	U
Methyl ethyl ketone	SS	SS	S	S
Ethyl alcohol	SS	SS	SS	SS
Ethylene glycol	U	U	U	U
Butyl acetate	U	SS	SS	SS
Dibutyl phthalate	U	U	U	U
Perchlorethylene	U	U	U	U
Toluene	U	U	U	SS
Kerosene	U	U	U	U
Sour crude	U	U	U	U
Motor oil	U	U	U	U
JP-4 fuel	U	U	U	U
SR-6 aromatic fuel	U	U	U	U
Corn oil	U	U	U	U
Water	U	U	U	U
Sea water	U	U	U	U
Tide, 10% by wt.	U	U	U	U

[a]Code for condition: U = Unaffected; SS = slightly softened; S = softened; BL = Blistered; F = Failed

brush, roller coating, and trowel application can be formulated.

Fillers, pigments, dyes, and various diluents can be incorporated into either one or both parts. Different types of fillers such as titanium dioxide, zinc oxide, silicon dioxides, powdered aluminum, and the carbon blacks may be used in these coatings. Aluminum-type fillers must not be added to the polysulfide component part as the amine reacts with them on prolonged contact.

Application techniques: Although it is not necessary to employ complicated cleaning procedures in the application of these coatings, clean and dry surfaces are important. Grease or oil, loose corrosion products, dirt, and excess moisture must be removed before applying the coating. Wire brushing, sandpapering, or light sandblasting followed by a solvent wash are very satisfactory surface preparations for steel. Freshly machined metal surfaces need only a solvent wash to remove any oil present. Phenolic-zinc chromate-type primers enhance the adhesion of the coatings to steel in applications requiring extended periods of immersion in water.

Since the coatings develop excellent adhesion properties to relatively dry and clean wood surfaces, no special surface preparation is required. Rigid plastic surfaces should be sanded and wiped with a suitable solvent to remove any surface imperfections and mold release agents. Natural and synthetic rubber surfaces should be cyclized with sulfuric acid to obtain optimum adhesion.

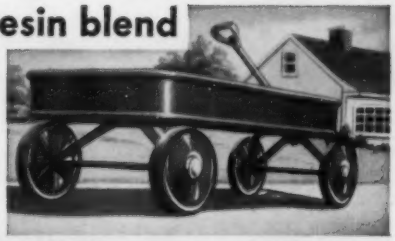
Seven- to 10-mil, unpigmented films, which possess good anti-sag characteristics on vertical surfaces, can be deposited in one coat with conventional spray equipment. The coatings are adaptable for spraying at 100% solids with hot-spray equipment. Elevated temperatures can be employed to reduce the viscosity of the polymers to a spraying range. The liquid polysulfide polymer-amine mixture and epoxy resin blend can be heated separately and proportioned through separate lines to a special type spray gun designed

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Table VII: Experimental liquid polysulfide polymer-epoxy adhesives

Components	Adhesive T-120-1		Adhesive T-120-2		Adhesive T-120-3		Adhesive T-120-6	
	Part A	Part B	Part A	Part B	Part A	Part B	Part A	Part B
LP-3	100	—	100	—	100	—	100	—
Epiphen ER-823	—	400	—	—	—	—	—	—
Epon 828	—	—	—	100	—	100	—	300
Araldite CN-503	—	—	—	—	—	25	—	—
Araldite CN-504	—	—	—	100	—	—	—	—
AFD filler[a]	—	80	—	—	—	—	—	—
Burgess pigment No. 20[b]	—	—	71	79	64	49	27	33
Catalyst EC-1[a]	40	—	—	—	—	—	—	—
DMP-30	—	—	15	—	10	—	—	—
Shell catalyst D	—	—	—	—	—	—	40	—
LP/EP ratio	¼		½		1/1.25		⅓	
Part A/part B ratio	1/3.4		1/1.5		1/1		½	

[a]The Borden Co., Chemical Div.
[b]Burgess Pigment Co.

Table VIII: Effect of fillers on shear strength (7)

Adhesive composition					
Epoxy resin	100	100	100	100	100
LP-3	10	10	10	—	—
Milled glass fibers	—	10	—	—	—
Domestic china clay	—	—	50	—	50
Dimethylaminoethyl alcohol[a]	4	4	4	4	4
Triethylamine[a]	4	4	4	—	—
Shear strength after 0.75-hr. cure at 180°F.					
Tested at 80°F., p.s.i.	2600	2900	2860	2070	2400
Tested at 250°F., p.s.i.	500	430	640	750	830

[a]Carbide and Carbon Chemical Co.

either for internal or external mixing. If the coating composition is to be used within 48 hr., the polysulfide can be incorporated in the epoxy blend as one component with the amine constituting the second component part. The polysulfide/epoxy blend can be sprayed at a lower temperature than the epoxy blend, and the amine need not be heated. Advantages of hot spraying polysulfide/epoxy blend coating systems at 100% solids would be: faster set, shorter tack free time, more rapid cure, and thicker films with good anti-sag and fewer "holidays."

Curing: Films cured with organic amines at room temperature possess many of the attributes of baked coatings. The type and quantity of amine used have an important bearing on the curing characteristics and properties of the films. Because of the rapid cure and good properties of films converted with tri-(dimethylaminomethyl) phenol, this amine was used most extensively. Elevated temperatures can be used to accelerate the cure as required for diverse industrial applications. The broad range of cures adaptable to these coatings is shown in Table III, p. 188.

Evaluation procedures: Film properties determined on 5- to 7-mil coatings sprayed on 0.034 by 3- by 6-in. steel panels and cured 7 days at room temperature.

Pot life of mixed coatings at room temperature—Determined as the time from start of mixing a 150-cc. volume during which it could be sprayed without further dilution with thinner to give a good uniform film.

Set time—Time required before the film exhibited no sagging tendency on a vertical test panel.

Tack free time—Determined as the time required for the film to become tack free to touch.

Flexibility—Evaluated with the rod test and conical mandrel after 8-mo. aging.

Direct impact resistance—Measured on the film with the Gardner variable impact tester.

Scratch resistance—Qualitatively determined as the resistance of the film to scratching with a knife blade.

Adhesion—Determined qualitatively with a knife blade.

Chemical and solvent resistance—The films were exposed to the chemical solutions and solvents contained in wide mouth jars clamped to the test panels.

Properties of coatings

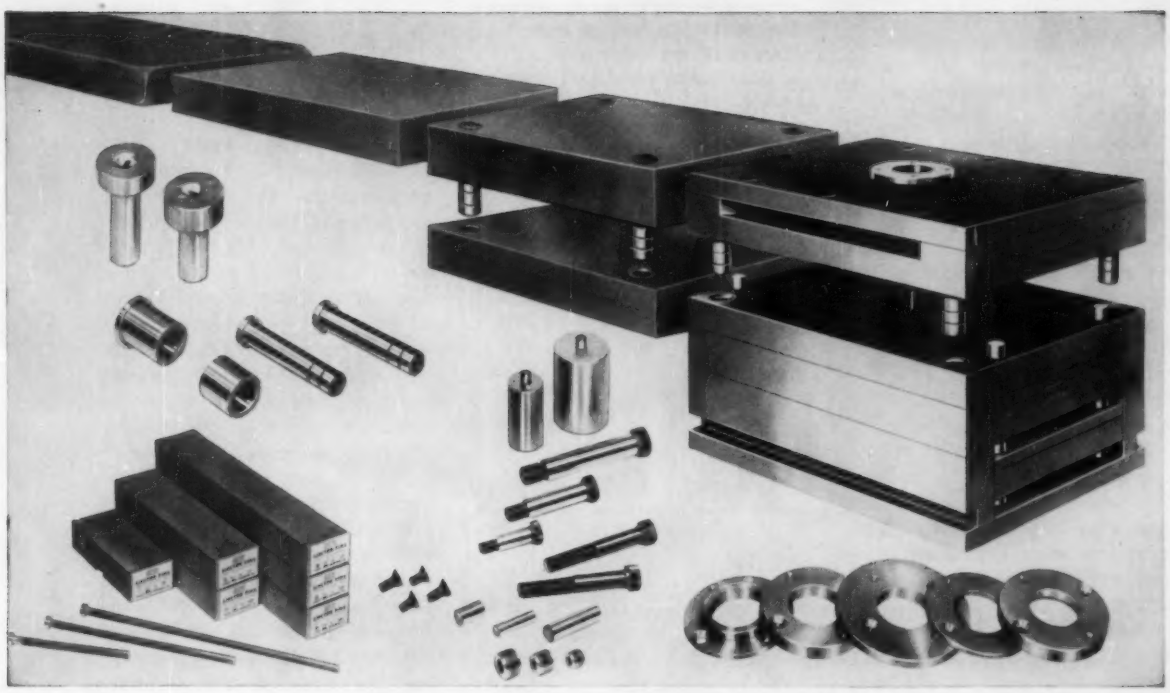
Three typical, experimental coating systems made with polysulfide and liquid-solid epoxy blends are listed in Table IV, p. 189. The working, curing, and physical properties of these coatings are presented in Table V, p. 189. They possess a practical pot life of 3 to 5 hr., which can be lengthened, without radically affecting the cure, by increasing the amount of solvent. Films applied at 75 to 85% solids with conventional spray equipment soon become tack free at room temperature and can be handled within 2 to 5 hours.

Cured films of these coatings show excellent flexibility. Five- to 7-mil films are unaffected

when bent over a 0.125-in. rod

Table IX: Effect of lapo

resistance to corrosion, chalking,



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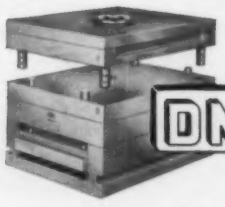
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when bent over a 0.125-in. rod and have over 38% elongation by the conical mandrel test after 7 days' cure at room temperature. Elongation of T-140-1 and T-140-3 films decreases only 3 to 6% on shelf aging. In applications where a coating with a very high degree of flexibility is required, the polysulfide content is increased. Figures 1 and 2, p. 190, show that, within the limits investigated, percentage elongation and impact resistance of a typical coating increase directly with the amount of polysulfide used. When the amount of liquid polysulfide polymer in the epoxy/polysulfide blend is 40% or over, the percentage elongation and impact resistance are too high for measurement on the conical mandrel and standard Gardner variable impact tester.

The dry adhesion of these coatings is excellent to dry porous surfaces and good to a variety of unprimed metals. Coatings prepared with the higher-molecular-weight epoxy resins, such as Epon 1007, display better adhesion than those containing Epons 1004 and 1001. This is shown in the adhesion data obtained on coatings T-140-1 and T-140-3 recorded in Table V. Polysulfide polymer enhances the wetting and adhesive properties of epoxy coatings with minimized undercutting and corrosion on metal surfaces immersed in aqueous media.

Although these coatings were not formulated for maximum scratch resistance, they rated good in this property. As the concentration of polysulfide liquid polymer is decreased, films of better scratch resistance are obtained.

Table IX: Effect of leno glass cloth on shear strength of polysulfide-modified epoxy adhesives

	Adhesive T-120-1	*Adhesive T-120-2*
Shear strength at 80°F. after 1-hr. cure at 250°F.		
With glass cloth, p.s.i.	3500	4100
	3200	4000
	3140	4280
	3280 av.	4130 av.
Without glass cloth, p.s.i.	3350	4010
	3100	3900
	3520	4040
	3320 av.	3980 av.

The data in Table VI, p. 190, show that in general the room-temperature chemical resistance of these coatings is good. However, in 50% concentrations, by weight, of nitric, sulfuric, and acetic acids and 10% acetic acid they show poor chemical resistance. Exposure to methyl ethyl ketone, ethyl alcohol, and butyl acetate results in very slight softening of the films. After 5 mo. immersion at 130° F., these coatings display excellent resistance to SR-6, 40% aromatic fuel, and JP-4 jet fuel, and possess good resistance to tap and sea water (no creep corrosion).

Typical coatings possess good resistance to corrosion, chalking, pitting, blistering, and wrinkling after 500 hr. exposure in an Atlas twin-arc Weatherometer with intermittent water spray.

The properties of these coatings can be altered to meet specific requirements by 1) adjusting the ratio of polysulfide polymer to epoxy resin, 2) varying the liquid epoxy/solid epoxy ratio of the epoxy resin blend, 3) use of different types of amines, and 4) varying the amount and type of diluents. Films of optimum chemical and solvent resistance are obtained with polysulfide/epoxy ratios less than one. Flexibility of the coatings can be varied from rubber-like to hard and tough. With an increase in the amount of solid epoxy in the liquid-solid epoxy blend, shorter tack-free time and improved anti-sag properties on vertical surfaces are obtained. By changing the type of amine, longer tack-free and cure times can be achieved. The amount of gloss and the color of the films are also dependent on the type of amine employed. It is possible to vary pot life and applicability by adjustment of the amount and type of diluents. Coating compositions from 100% solids applied by hot spraying with 10- to 15-min. cure times to low solids with long pot life and cure time are obtainable.

Adhesive compositions

The epoxy resins are the basis for some of the most versatile adhesives introduced to the trade to date. Because of their basic structure and high polarity they develop adhesion to nearly any clean surface with the exception of very non-polar adherends. Epoxy adhesives are supplied in both hot- and cold-setting types. The cold-setting types are prepared with the lower-molecular-weight liquid epoxy resins and can be applied at 100% solids. They are cured with various types of organic amines and give high bond strengths in the bonding of aluminum, steel, brass, glass, ceramics, wood, plastics, rubber, and leather to themselves or to each other at room temperatures with only contact pressure. These adhesives are, however, lacking in peel, bend strength,

Table X: Shelf-aging stability of experimental liquid polysulfide polymer/epoxy adhesives at 80°F.

	Adhesive T-120-1		*Adhesive T-120-2*	
Viscosity at 80°F.	*Part A*	*Part B*	*Part A*	*Part B*
No aging, poises	2	5240	2500	230
After 1 wk., poises	—	—	2500	130
After 1 mo., poises	4	5500	4000	175
After 2 mo., poises	5	6000	3800	250
After 3 mo., poises	5	5600	4900	265
Shear strength at 80°F. before and after shelf-aging of adhesive parts; 1-hr. cure at 250°F.				
No aging, p.s.i.	3600		4500	
After 6-mo. aging, p.s.i.	3450		4100	

Table XI: Properties of experimental polysulfide-modified epoxy adhesives[a]

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In cents per pound volume

RECIPE	PARTS
PVC Resin	100
Cabflex® DOP	25
Low Temperature Plasticizer	As Shown
Basic Lead Carbonate	1.6
Lead Stearate	0.5

Compare	*Cabflex®* **DDA**	**DOS** *di-octyl sebacate*	**Di-OZ** *di-iso-octyl azelate*	**DOA** *di-2-ethylhexyl adipate*
Parts Low Temperature Plasticizer[1]	22.7	21.0	21.5	20.0
COST				
Pound Volume Cost of Compound	35.7¢	39.4¢	37.2¢	35.8¢
VOLATILITY[2]				
@ 70° C.—Weight Loss %	0.75	0.75	0.92	1.6
@ 90° C.—Weight Loss %	3.6	3.6	3.3	6.0
LOW TEMPERATURE PROPERTIES				
Clash and Berg—Tf[3]	−29.4° C.	−30.5°C.	−29.3°C.	−28.4°C.
Brittleness—SPI Impact[4] Passed	−35.0° C.	−35.0°C.	−30.0°C.	−30.0°C.
Failed	−40.0° C.	−40.0°C.	−35.0°C.	−35.0°C.

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Table XI: Properties of experimental polysulfide-modified epoxy adhesives[a]

	Adhesive T-120-1	*Adhesive T-120-2*	*Adhesive T-120-3*	*Adhesive T-120-6*
Liquid polymer/epoxy ratio	1/4 LP-3/Epiphen ER-823	1/1/1 LP-3/Epon 828/ CN-504	1/1/0.25 LP-3/Epon 828/ CN-503	1/3 LP-3/Epon 828
Working properties of mixed adhesives				
Viscosity at 80°F., poises	170	205	390	70
Working life at 80°F., hr.	1.5	0.5	0.5	8
Maximum temperature rise, °F.	122	142	155	90
Optimum cure	1 hr. at 250°F.	1 hr. at 250°F.	0.5 hr. at 250°F.	2 hr. at 250°F.
Shear strengths at 80°F. after different cures[a]				
7 days at 80°F., p.s.i.	1100	2000	2500	No cure
30 days at 80°F., p.s.i.	1500	1500	2100	No cure
Optimum cure at 250°F., p.s.i.	3600	4500	3800	4300
Shear strengths after optimum cure at 250°F.				
Tested at 80°F., p.s.i.	3600	4500	3800	4300
Tested at 180°F., p.s.i.	1200	1100	400	300
Tested at —67°F., p.s.i.	1800	2200	2000	2600
Peel and bend strength at 80°F. after optimum cure at 250°F.				
Peel, lb./in.	19	18	27	36
Bend strength, lb./0.5 sq. in.	157	139	189	227
Shear strengths after optimum cure at 250°F. and immersion at 80°F. for 30 days				
Tap water, p.s.i.	3200	800	1200	2700
Sea water, p.s.i.	2900	1100	700	2800
Type III aromatic fuel, p.s.i.	3300	3400	3200	3600
JP-4 fuel, p.s.i.	3400	3200	2800	3400
Engine oil, p.s.i.	3500	3200	3100	3100
Isopropyl alcohol, p.s.i.	3700	3200	2800	3500
Ethylene glycol, p.s.i.	3400	3700	3600	2900
Methyl ethyl ketone, p.s.i.	2700	400	Disintegrated	2600
Dibutyl phthalate, p.s.i.	3200	3400	3500	4100
10% soln. $Al_2(SO_4)_3$, p.s.i.	3200	2000	1800	2800
10% soln. Na_2CO_3, p.s.i.	3500	2800	1400	3600

[a]Bonds prepared with 4- to 5-mil leno glass cloth SM No. 273 as a spacer to control glue line thickness.

impact resistance, and resistance to thermal softening and creep at temperatures exceeding 160° F.

Liquid polysulfide polymer-epoxy adhesives possess a number of properties unobtainable with either polymer alone. They develop the same excellent adhesion properties to the wide range of surfaces as the unmodified epoxy adhesives. The modified adhesives can be cured with organic amines at either room or elevated temperatures as dictated by the specific requirements of the application and formulation. However, higher bond strengths are obtained with elevated temperature cures. Polysulfide modified epoxy adhesives develop low shrinkage during conversion which minimizes bond strains. The adhesives possess better wetting properties, flexibility, peel, bend and impact strength, shear bond strength with room-temperature cures, low-temperature shear bond strength, and high strength after immersion in water and other solvents. Modification of epoxy adhesives with polysulfide polymer does not enhance thermal softening and creep.

Formulation: The following primary materials are used in the formulation of polysulfide/epoxy adhesives: 1) liquid polysulfide polymers, 2) liquid epoxy resins, 3) organic amines, and 4) various types of fillers. It is possible by varying the quantity and type of each material to obtain variations in working life, cure rate, and adhesive properties. These adhesives can be compounded for brush, blade, or roller-coat application and can be prepared as two-package mixes. Usually one part consists of the liquid polysulfide polymer, organic amine, and part of the filler and the other part contains the epoxy resin and remainder of the filler. The fillers can be readily dispersed into the liquid polymer and epoxy resin by paint milling.

Although all of the commercial liquid polysulfide polymers can be used for the modification of epoxy adhesives, LP-3 has been used most extensively. The higher-molecular-weight LP-2 is not as compatible with the liquid epoxy resins as LP-3 and also gives adhesives with higher mix viscosities. Therefore, it is not as

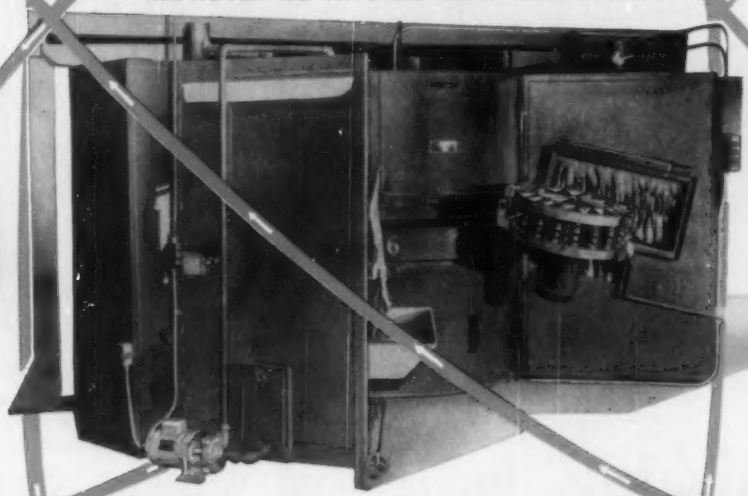
Table XII: Polysulfide modi-

versatile for formulating adhe-

liquid polysulfide polymer-epoxy adhesives to reduce the cost and

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Table XII: Polysulfide modified epoxy adhesive properties[a]

	Adhesive T-120-2	*Adhesive T-120-3*
Shear strength of various surfaces at 80°F.		
Aluminum to wood	810/WF	970/WF
Aluminum to glass	250/GF	240/GF
Peel strength at 80°F.		
Tin to tin	22.5	35

[a]Adhesive cured 0.5 hr. at 250° F. WF = wood failure; GF = glass failure

versatile for formulating adhesives.

There are several commercially available liquid epoxy resins that are suitable for the preparation of these adhesives. Shell Chemical Corp., Ciba Co., Inc., Bakelite Co., and The Borden Co. market such liquid epoxy resins. However, most of our development work with the modified adhesives was conducted with Epon 828 (Shell Chemical Corp.), Epiphen ER-823 (The Borden Co.), and the Araldites CN-503 and CN-504 (Ciba Co.). Formulations of typical experimental adhesives are given in Table VII, p. 192.

Various types of fillers can be used in the compounding of liquid polysulfide polymer-epoxy adhesives to reduce the cost and improve certain properties. Fillers such as aluminum powder, carbon black, short fiber asbestos, silica powder, zinc dust, Silene EF, and ignited alumina have been investigated in epoxy adhesives (6). Although these fillers did not improve shear strengths at low or room temperatures, they increased elevated temperature and water resistance properties. Aluminum powder was the best filler for obtaining optimum shear strengths at elevated temperatures and after water immersion. Milled fibrous glass and domestic china clay have been investigated in epoxy and polysulfide modified epoxy adhesives for their effect on shear strengths (7). The results of this work are shown in Table VIII, p. 192. Fifty parts of domestic china clay improved the shear strength of the epoxy and polysulfide modified epoxy adhesives at 80 and 250° F.

Surface preparation: Proper surface preparation is of paramount importance for obtaining good bond strengths. In the bonding of metals and other types of hard, dense materials, clean and smooth surfaces are essential. The surface should be dry and free of grease or oil film, rust, and scale. Although for some applications simple solvent-degreasing gives satisfactory results with metals, acid-etching is recommended for high and consistent bonds. Etching with chromic acid is especially good for preparing aluminum and glass surfaces. Degreasing by immersion in a 10% solution of sodium meta-silicate for 10 min. at 140° F. followed by a water wash, then brightening by a short immersion in 85% phosphoric acid, rinsing, and drying is a good surface preparation for steel. Brass, bronze, and copper can be satisfactorily cleaned by etching in a ferric chloride, concentrated nitric acid solution.

Natural and synthetic rubber must be cyclized with sulfuric acid prior to bonding. Surface contaminants, such as mold release agents, which are usually present on plastic surfaces,

(*To page* 203)

Table XIII: Comparison of unmodified and polysulfide-modified epoxy formulations[a]

	Epoxy adhesive control		*Adhesive T-120-3*	
Components	*Part A*	*Part B*	*Part A*	*Part B*
LP-3	—	—	100	—
Epon 828	—	100	—	100
CN-503	—	25	—	25
Burgess pigment No. 20	—	62	64	49
DMP-30	10	—	10	—
LP-3/Epon 828/CN-503 ratio	0/1.25		1/1.25	
A/B ratio	—		1/1	
Working properties				
Viscosity, poises	520		390	
Working life at 80°F., hr.	0.5		0.5	
Maximum temperature rise, °F.	101		155	
Shear strength at 80°F. after various cures				
7 days of 80°F., p.s.i.	300		2500	
30 days at 80°F., p.s.i.	400		2100	
0.5 hr. at 250°F., p.s.i.	1100		3800	
Shear strength after 0.5-hr. cure at 250°F.				
Tested at 80°F., p.s.i.	1100		3800	
Tested at 180°F., p.s.i.	2100		400	
Tested at —67°F., p.s.i.	1800		2000	
Peel and bend strength at 80°F. after 0.5-hr. cure at 250°F.				
Peel, lb./in.	Broke on placing in test jig		27	
Bend strength, lb./0.5 sq. in.	35		189	
Shear strengths after 0.5-hr. cure at 250°F. and immersion at 80°F. for 30 days				
Tap water, p.s.i.	0		1200	
Type III aromatic fuel, p.s.i.	900		3200	
Isopropyl alcohol, p.s.i.	1000		2800	
Dibutyl phthalate, p.s.i.	900		3500	
10% soln. Na_2CO_3, p.s.i.	600		1400	

[a]Bonds prepared with 4- to 5-mil leno glass cloth SM No. 273 as a spacer to control glue line thickness.





Extruded polyethylene sheet entering special multiple-roller take-off machine designed and built by Bakelite Company laboratory.

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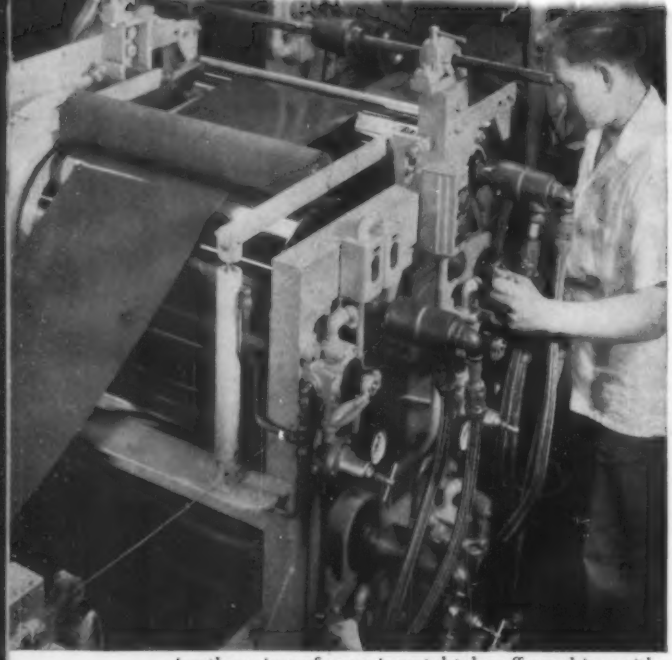
New Polyethylene DFD-4030 and Impact Styrene TGD-5001

The extrusion and vacuum-forming equipment shown on these pages occupies an important position in the Bakelite Company Extrusion Laboratory at Bound Brook, N. J. It was designed and constructed by Bakelite Company, and has helped to develop plastic compounds engineered to perform with peak efficiency in commercial production.

As a result of this activity, Bakelite Company has accumulated a fund of information on these materials that will benefit fabricators and end-users alike. It is readily available to you through the services of qualified Bakelite Company representatives.

The following pages illustrate and describe the new BAKELITE Polyethylene compound DFD-4030 and the well established BAKELITE Impact Styrene extrusion compound TGD-5001.

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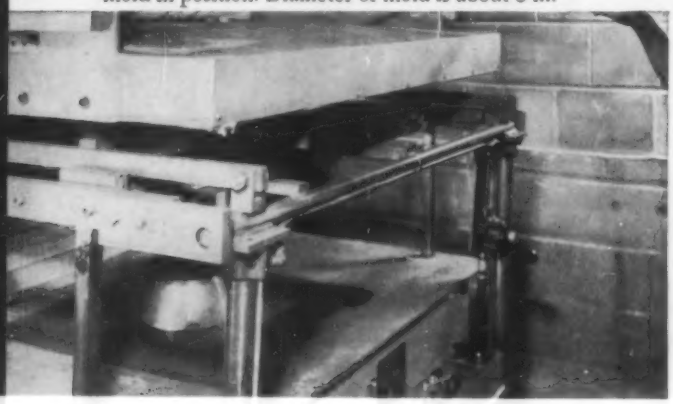


Another view of experimental take-off machine with sheet emerging.



Placing polyethylene sheet in clamping frame of vacuum-forming machine.

Heater drawn forward over polyethylene sheet, with bowl mold in position. Diameter of mold is about 8 in.



Two superior materials

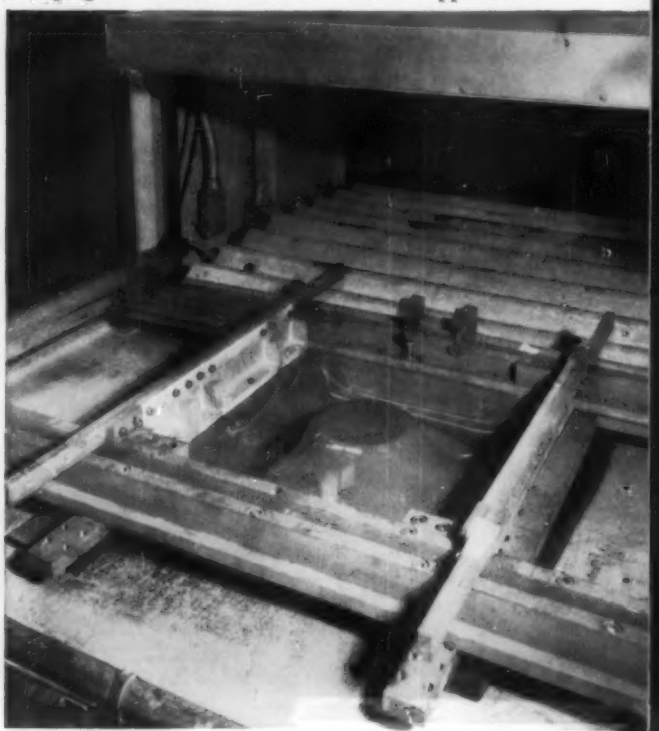
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New BAKELITE Brand Polyethylene Compound DFD-4030

DFD-4030 possesses these natural advantages for sheet extrusion and for vacuum-forming:

1. Compounded specifically for these processes.
2. Has melt index of approximately 2.0, indicating good resistance to stress cracking and freedom from skinning and chatter marks.
3. Permits continuous, in-line production where sheet extruder is connected to vacuum-forming machine.
4. Achieves a superior gloss and finish.
5. Permits complete dispersion of colorants and the elimination of streaking.

Draping heated polyethylene sheet over bowl mold as clamping frame descends before vacuum is applied.



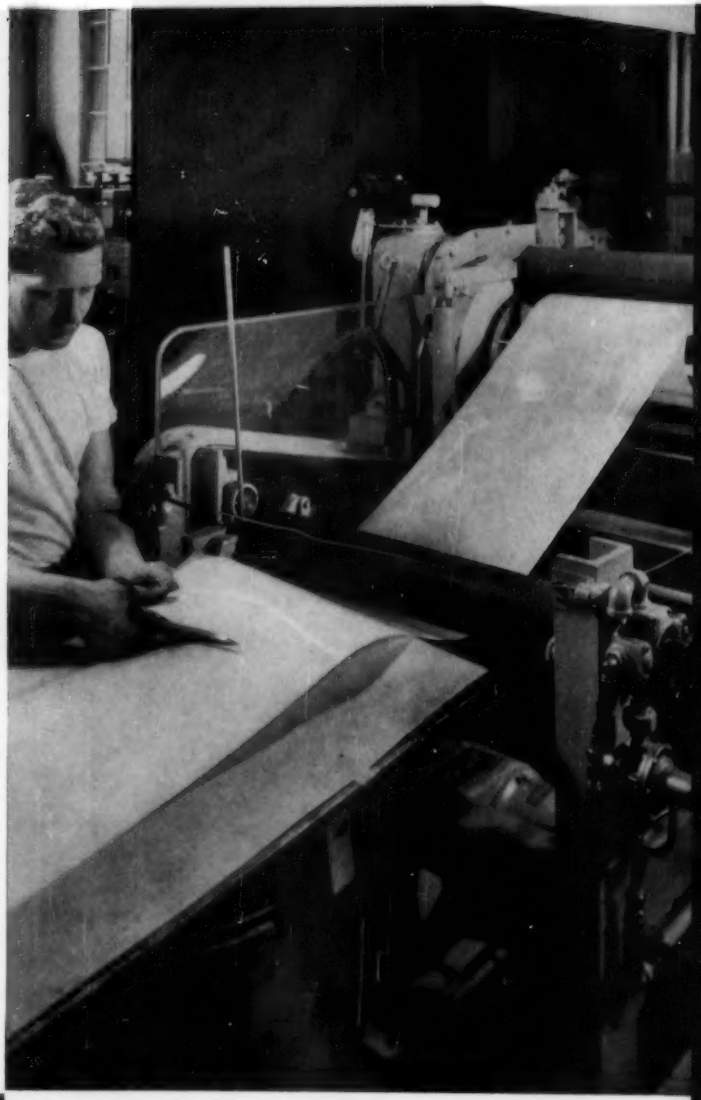
BAKELITE Brand

Impact Styrene Compound

TGD-5001

This companion to the new polyethylene, is already well established as a result of these features:

1. Offers the highest gloss yet attained in an impact styrene for extruded sheet.
2. Takes on permanent high gloss as it comes from the extruder—post finishing is not essential.
3. Retains gloss throughout deep drawing operations because it is not subject to plastic memory effect.
4. Exhibits sufficiently high heat-stability to permit recycling through the extruder.



Styrene sheet retains the high gloss it exhibits here as it emerges from take-off machine.

Strength in thin sections afforded by TG-5001 makes these dishes and trays a useful addition to the modern kitchen. Note superior gloss!



For information on the properties and uses of BAKELITE Polyethylene DFD-4030 and Impact Styrene TGD-5001, write Dept. SZ-104.

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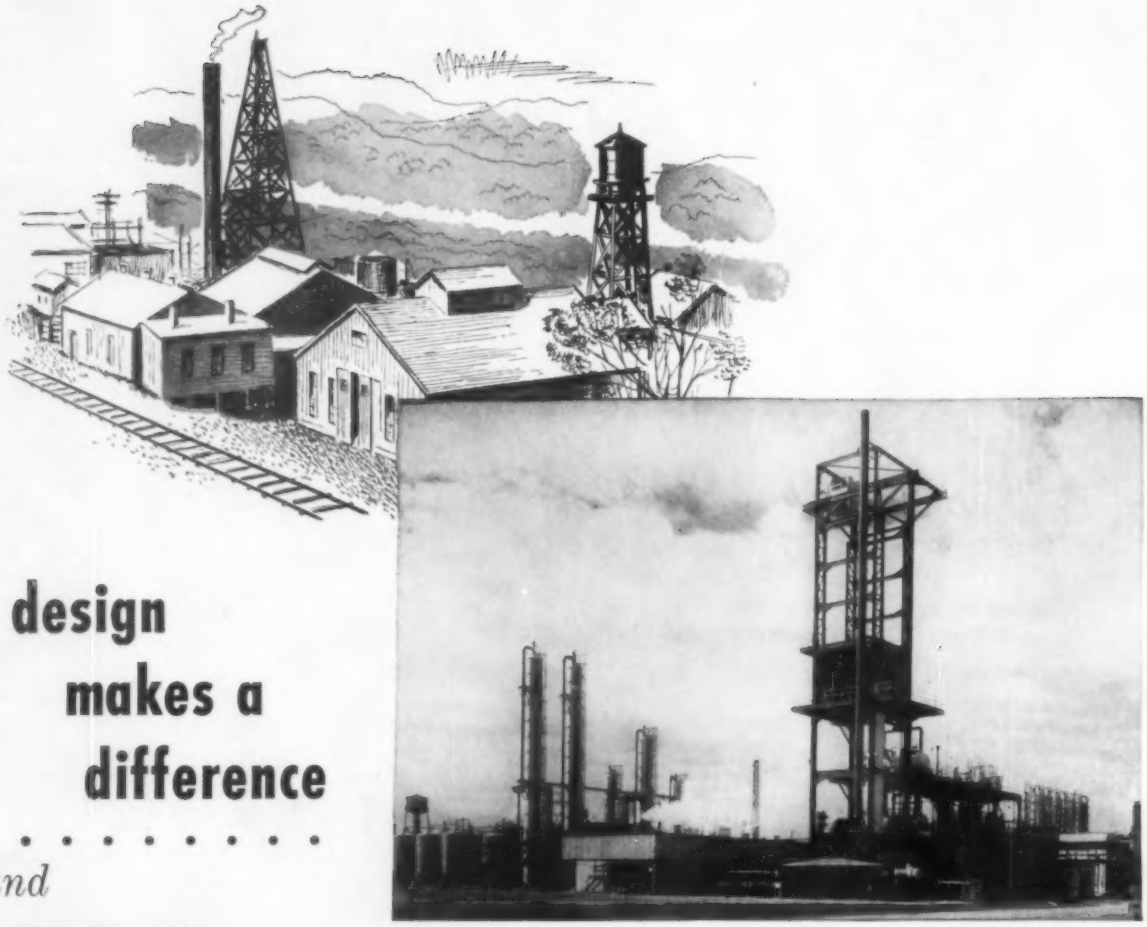
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Table XIV: Comparison of shear and bend strengths of epoxy

ethylenediamine and other poly-
ethylene amines give a highly



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strength can be varied by modi-

T-120-1 and cured 7 days at room

Table XIV: Comparison of shear and bend strengths of epoxy adhesives with and without polysulfide (7)

Components	*Adhesive FPL-828*		*Adhesive FPL-852a*		*Adhesive FPL-852*	
Epoxy resin	100		100		100	
LP-3	10		—		—	
LP-2	—		20		—	
Resorcinol	—		20		20	
Milled glass fibers	10		—		—	
Dimethylaminoethyl alcohol	4		—		—	
Triethylamine	4		—		—	
Soln. of hexamethylenetetramine[a]	—		25		25	
Working life,[b] hr.	2.5		1.5		—	
Cure	8 days at 80°F.	1 hr. at 200°F.	8 days at 80°F.	1 hr. at 200°F.	8 days at 80°F.	1 hr. at 200°F.
Shear strength						
Tested at 80°F., p.s.i.	1660	2895	1080	2060	[c]	1860
Tested at 250°F., p.s.i.	220	436	450	1785	[c]	2095
Bend strength at 80°F., lb./0.5 sq. in.	108	174	104	138	—	44

[a]45% by weight hexamethylenetetramine in water.
[b]Approximately 50 gram mass.
[c]Broke during handling.

should be removed by buffing or wiping with a suitable non-reactive solvent. Adherends that are porous do not require special surface preparation providing they are clean and dry. Wood surfaces should be planed to obtain bonds of maximum structural strength.

Mixing and application: Since the adhesives commence to cure when the reactive components are mixed together, they should not be mixed until immediately before use in order to obtain maximum working life. Propeller- and paddle-type mixers or a Baker-Perkins-type internal mixer are satisfactory for this purpose. Simple mixing with a spatula on a plate is adequate for small batches. Whatever method is used for mixing, precautions should be exercised to eliminate entrapped air in the adhesive to prevent deleterious effects on the bond strengths.

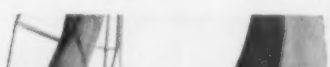
The adhesive must be applied evenly on both bonding surfaces and the bond made during the "wet" stage. The thickness of the glue line is a most important factor in obtaining good bond strengths. Usually thin glue lines give higher shear strengths. The design of the joint and the type of stress imposed on the bond determine to a great extent the optimum glue line thickness (8). A 5- to 7-mil glue-line thickness gives good results in most applications.

A practical method for controlling the glue line thickness in many bonding operations consists in embedding a strip of square open mesh, 4- to 5-mil gage, glass cloth in the adhesive layer on one of the surfaces prior to bonding. Leno glass cloth SM No. 273 (Soule Mills, Inc.) is very adaptable for this purpose. The data in Table IX, p. 000, show that this glass cloth does not significantly affect room temperature shear strengths.

Curing: The working properties, cure characteristics, and bond strengths of the adhesives are dependent to a great extent on the structure and concentration of amine used in the formulation. Therefore, it is necessary to determine the amount and type of amine to give the desired adhesive properties. Studies conducted on the curing of an epoxy adhesive with various types of amines showed that the structure of the amine not only determined the cure rate but also the heat resistance of the adhesive (7). Primary and secondary amines such as tetraethylenepentamine, ethylenediamine and other polyethylene amines give a highly exothermic reaction, short working life, high room-temperature shear and bend strengths with room-temperature cure, and poor strength at elevated temperatures, and do not develop appreciably higher strengths with heat cures. Methyl groups attached to the nitrogen contribute to rate of cure and extent of cross-linking which improve the thermal resistance of the adhesive. Dimethylaminoethyl alcohol was indicated to be a particularly good amine for curing polysulfide modified epoxy adhesives in these respects.

A number of commercial organic amines are useful in curing liquid polysulfide polymer-epoxy adhesives. It has been observed that the reactivity of various amines in thin films cannot always be predicted by their reactivity as determined in a confined mass of 100 to 300 grams. Because of the high surface-to-volume ratio of relatively thin films, the heat of reaction is rapidly dissipated and is not available to as great an extent for accelerating the reaction rate. The amount of amine used in these adhesive formulations varies from about 7 to 10 parts per 100 parts of epoxy resin depending upon its reactivity and the properties desired in the cured adhesive.

Evaluation procedures:
Viscosity of mixed adhesives—Determined at 80° F. with a 110-cc. volume in a container 2.25 in. in diameter and 2.25 in. high with a Brookfield viscometer 7 min. from the time the component parts were mixed together.
Working life of mixed adhesives at 80° F.—Time from start of mixing 110-cc. volume during which it could be spread to wet the bonding surface satisfactorily.
Maximum temperature rise—Determined on a 110-cc. volume of adhesive described in (1).
Tensile shear strengths at various temperatures and after immersion in various solvents—Determined with 0.064-in. Alclad 24ST aluminum alloy, 0.5-in. lap joint test specimens in accordance with specifications Mil-A-8331 (USAF) on Adhesives; Aircraft Structural, Metal to Metal.



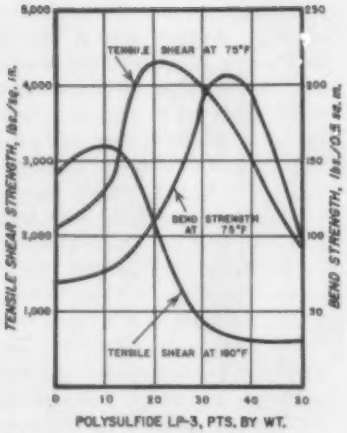


Fig. 3: Effect of liquid polysulfide polymer on properties of Epiphen epoxy adhesive. (Graph, The Borden Co., Chem. Div.)

Bend strength—Conducted according to specification Mil-A-8331 (USAF).

Peel—Ciba peel test employed ("Redux in Aircraft," 71-73, N. A. deBruyne, Ciba Company, Inc., N. Y., 1st ed., 1953). Test strips were made with 0.032 by 1 in. Alclad 24ST aluminum alloy.

Although firm contact pressure is adequate for most bonding operations, a pressure of 10 p.s.i. was employed to insure reproducible joints.

Properties of the adhesives

Two-part liquid polysulfide polymer-epoxy adhesives possess good shelf-aging stability at 80° F. This property was studied by determining the viscosity of the separate parts of the adhesives with a Brookfield viscometer after various periods of time. Also, the shear strengths of the adhesives before and after 6-mo. shelf aging were determined. Typical data obtained with two of the adhesives listed in Table VII are recorded in Table X, p. 194.

A number of important properties determined on the four experimental liquid polysulfide polymer/epoxy adhesive formulations listed in Table VII are recorded in Table XI, p. 196. It is evident that such properties as mix viscosity, working life, shear bond strength at various temperatures, and peel and bend strength can be varied by modification of the adhesive formulation to meet specific application requirements. These formulations were not developed with the objective of obtaining optimum specific properties, but rather to serve as a basis for compounding adhesives for diverse applications. Shear strengths as high as 2500 and 4500 p.s.i. were obtained, respectively, with room- and elevated-temperature cures. Although elevated-temperature shear strengths were not outstanding, values of 1200 p.s.i. at 180° F. were obtained with elevated-temperature cures. Peel values of 36 lb./in. and bend strengths of 227 lb./0.5 sq. in. were achieved with elevated-temperature cures. In addition, high shear strengths were obtained after immersion in various solvents.

Shear strengths of various surfaces bonded with two typical liquid polysulfide polymer-epoxy adhesives and tin-to-tin peel values obtained are presented in Table XII, p. 198 (5). The aluminum to plywood and aluminum to glass shear strengths obtained were in excess of the cohesive strength of the plywood and glass test specimens. Ninety-degree strip-peel values from 22 to 35 lb./in. were easily obtained. Steel-to-steel lap joints bonded with polysulfide-epoxy adhesive T-120-1 and cured 7 days at room temperature developed tensile shear strengths in the order of 1600 p.s.i. at 80° F. When cured 1 hr. at 200° F., room-temperature shear strengths in the range of 3200 to 3900 p.s.i. and tensile strengths around 2500 p.s.i. have been obtained. Room-temperature tensile strengths of 400 to 500 p.s.i. have been reported for cyclized neoprene bonded to steel at 250° F. for 1 hr. with T-120-1 adhesive. Also, impact strengths exceeding 75 ft.-lb./sq. in. with polysulfide-modified epoxy adhesives T-120-2 and T-120-6 were reported by fabricators.

A comparison of the properties obtained with a polysulfide-modified epoxy and a comparable straight epoxy adhesive formulation is shown in Table XIII, p. 198. The resultant effects of incorporating liquid polysulfide polymer in the epoxy resin adhesive are: 1) reduction in application viscosity without use of solvents which permits greater flexibility in formulating, 2) increased shear strength with room-temperature cure, 3) greatly improved room- and low-temperature shear strengths after curing at elevated temperature, 4) markedly increased peel and bend strength, and 5) higher shear-bond strengths after im-

(*To page* 294)

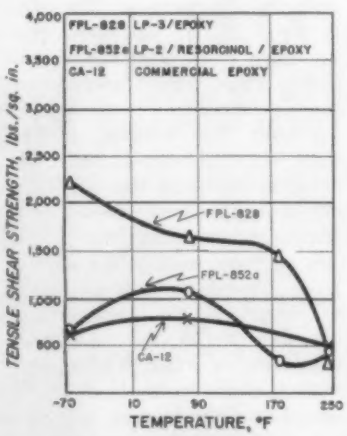


Fig. 4: Effect of temperature on shear strength of polysulfide-modified epoxy adhesives cured 192 hr. at 80° F. (U. S. Dept. of Agr., FPL report 2008)

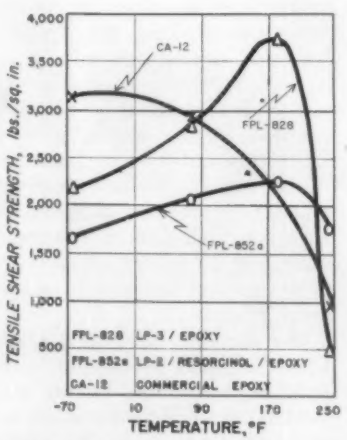
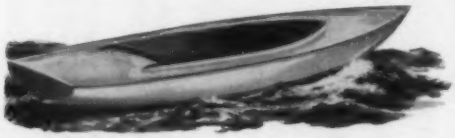


Fig. 5: Effect of temperature on shear strength of polysulfide-modified epoxy adhesives cured 1 hr. at 200° F. (U. S. Dept. of Agr., FPL report 2008)



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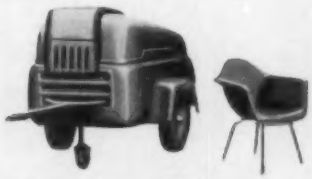
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Resin production

Data on poundage and unit values of materials produced in the United States during 1955, grouped by chemical composition*

Material	Production[a] 1000 lb.	Unit value per lb.[b] dollars
GRAND TOTAL	3,738,916	.33
COUMARONE-INDENE AND PETROLEUM POLYMER RESINS	292,574	.10
EPOXY RESINS:		
Unmodified: epichlorohydrin-phenol and bisphenol	20,974	.59
Modified	870	1.34
PHENOLIC AND OTHER TAR ACID RESINS, TOTAL	562,691	.26
Unmodified, total	505,759	.26
Bisphenol-formaldehyde	309	.73
p-tert-Butylphenol-bisphenol-formaldehyde	484	.54
p-tert-Butylphenol-formaldehyde	11,854	.38
Cresols-formaldehyde	7,192	.32
Cresylic acid-formaldehyde	10,452	.29
Phenol-formaldehyde	444,897	.25
Resorcinol-formaldehyde	3,513	.99
All others	27,058	.32
Modified, total	56,932	.28
Bisphenol-formaldehyde-rosin	4,278	.22
p-tert-Butylphenol-formaldehyde-rosin	4,446	.23
Phenol-formaldehyde-aniline	4,496	.31
Phenol-formaldehyde-rosin	25,432	.24
All others	18,280	.35
Phthalic anhydride-glycerol-pentaerythritol-styrene	2,447	.37
Phthalic anhydride-glycerol-styrene	10,141	.44
Phthalic anhydride-maleic anhydride-glycol-styrene	376	.50
All others	4,436	.48
Styrene-butadiene copolymer	127,117	.33
Styrene-divinylbenzene copolymer	25,728	.48
All other styrene resins	21,282	.33
ALL OTHER BENZENOID RESINS[d]	7,362	.55
Total for benzenoid resins	2,021,233	.27
ACETONE-FORMALDEHYDE RESINS	353	.29
ALKYD RESINS, EXCEPT PHTHALIC, TOTAL	87,221	.32
Unmodified, total	27,159	.48
Maleic anhydride-pentaerythritol	569	.32
All others	26,590	.48
Modified, total	60,062	.23
Fumaric acid-glycerol-rosin	4,494	.26
Fumaric acid-pentaerythritol-rosin	7,202	.30
Maleic-anhydride-glycerol-pentaerythritol-rosin	729	—
Maleic anhydride-glycerol-rosin	18,032	.22
Maleic anhydride-pentaerythritol-rosin	17,475	.21
Maleic-anhydride-pentaerythritol-tall oil	5,429	.12
All others	6,701	.26

PHTHALIC ANHYDRIDE ALKYD RESINS, TOTAL	455,994	.29
Unmodified, total	326,088	.30
Glycerol	142,348	.31
Glycerol-glycol	6,077	.31
Glycerol-glycol-pentaerythritol	1,515	—
Glycerol-pentaerythritol	42,166	.35
Glycerol-sorbitol	2,609	.37
Glycol-pentaerythritol	52,357	.27
Pentaerythritol	75,359	.28
All others	3,657	.28
Modified, total	129,906	.29
Adipic acid-glycol	349	—
Benzoic acid-glycerol	4,119	.45
Fumaric acid-glycerol	2,882	.39
Fumaric acid-glycerol-rosin	1,350	—
Glycerol-phenol-formaldehyde	3,364	.34
Glycerol-phenol-formaldehyde-rosin	6,779	.36
Glycerol-pentaerythritol-phenol-formaldehyde-rosin	4,320	.36
Glycerol-pentaerythritol-rosin and tall oil	11,658	—
Glycerol-rosin	30,932	.25
Maleic anhydride-glycerol	9,097	.32
Maleic anhydride-glycerol-pentaerythritol	9,073	.36
Maleic anhydride-glycerol-pentaerythritol-rosin	2,334	.39
Maleic anhydride-glycerol-rosin	1,399	.43
Maleic anhydride-pentaerythritol	4,615	.28
Maleic anhydride-pentaerythritol-rosin or tall oil	10,368	.32
Pentaerythritol-rosin or tall oil	13,006	.24
All others	14,261	.25
POLYESTER RESINS, TOTAL[c]	61,567	.40
Phthalic anhydride-maleic anhydride-glycol-styrene	31,001	.35
All others	30,566	.46
STYRENE RESINS, TOTAL	619,201	.32
Polystyrene	414,052	.29
Styrene-acrylonitrile copolymer	13,622	.41
Styrene-alkyd polyester resins, total	17,400	.44
POLYETHYLENE RESINS	402,279	.39
ROSIN AND TERPENE ADDUCT RESINS, TOTAL	4,038	.24
Fumaric acid-rosin	2,103	.21
All others	1,935	.26
ROSIN AND TALL OIL ESTERS, UNMODIFIED, TOTAL	57,830	.18
Rosin-glycerol	23,574	.18
Rosin-glycerol-pentaerythritol	1,766	.17
Rosin-pentaerythritol	20,046	.20
Tall oil-pentaerythritol	188	.15
All others	12,256	.15
SILICONE RESINS	2,957	2.99
UREA AND MELAMINE RESINS, TOTAL	328,381	.31
Urea-formaldehyde type, total	237,762	.24
Butylurea-formaldehyde	17,613	.42
Urea-formaldehyde	211,247	.22
All others	8,902	.39
Melamine-formaldehyde type, total	90,619	.48
Melamine-formaldehyde	64,891	.46
All others	25,728	.56
VINYL AND VINYL COPOLYMER RESINS[e]**, TOTAL**	703,259	.38
Polyvinyl acetate	72,946	.36
Polyvinyl chloride and copolymer resins (containing 50% or more polyvinyl chloride)	527,108	.34
All other vinyl resins[f]	103,205	.62
ALL OTHER NONBENZENOID RESINS[g]	131,365	.92
Total for nonbenzenoid resins	1,717,683	.41

[a]Source: U.S. Tariff Commission.
[b]Dry basis. For the purpose of this report, "dry basis" is defined as the total weight of the material, *including* resin, plasticizers, fillers, extenders, colors, and stabilizers, and *excluding* water, solvents, and other liquid diluents.
[c]Calculated on rounded figures.
[d]Polyester resins, for the purposes of this report, include unsaturated alkyds, copolymerized with monomers such as styrene, and polyallyl resin such as diallyl phthalate or allyl diglycol carbonate. Data for styrene-alkyd polyesters for protective coatings are not included in this group.
[e]Includes data for aniline-formaldehyde, toluenesulfonamide, and other benzenoid plastics and resin materials.
[f]Based on resin content only.
[g]Includes data for polyvinyl alcohol, butyral and formal, and for copolymers containing less than 50% polyvinyl chloride.
[h]Includes data for acrylic, polyamide, and other nonbenzenoid plastics and resin materials.

International standardization of plastics pipes

The second meeting of ISO/TC 5/SC 6 "Plastics Pipes" was held in Zurich, Switzerland, March 20-22, 1956, with D. I. van Wijk (Netherlands) presiding. The following countries were represented: Austria, Belgium, France, Germany, Italy, Netherlands, Sweden, Switzerland, and the United Kingdom.

The working groups and their programs are as follows:

Group a: General characteristics (leadership: France).

1) O.D. of plastics pipes.

2) Principles for specifying tolerances for outside diameters.

3) Pressures.

Group b: Testing of plastics pipes (leadership: Netherlands).

1) Dimensions.

2) Pressures to be sustained in long-time use.

3) Brittleness of plastics pipes at low temperatures (rigid PVC).

4) Effect of the pipes on water.

Group c: Technical requirements (leadership: Germany).

1) Procedure for calculating wall thickness of pipe (with Subcommittee ISO/TC 5/SC 8).

2) Technical requirements for rigid polyvinyl chloride and polyethylene pipes.

3) Acceptance tests for plastics pipes.

Group d: Fittings (leadership: Switzerland). (Established at Zurich meeting.)

General considerations

The following general principles for the standardization of plastics pipes were adopted by SC 6:

The outside diameters of circular plastics pipes shall conform to the following, regardless of production method, composition, or application: the outside diameters of plastics pipes in mm. shall be 2.5, 3, 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315, 355, 400. These figures shall be immediately used by the manufacturers as a guide and shall form the basis for establishing standards for a given material or a definite application. Larger diameters shall comply with the standardized values given in R 20 of ISO Recommendation No. 3.

Definitions for nominal and working pressures: The *nominal pressure* of a pipe is its working pressure at 20° C. The *working pressure* of a pipe is the maximum pressure to which the pipe may be subjected in long-time use. Nominal pressures of 1, 2.5, 4, 6, 10, and 16 kg./cm.^{2} were specified for plastics pipes. Higher nominal pressures may be used, if necessary. These pressures shall comply with standardized data in R 5 of ISO Recommendation No. 3.

The basic principle for specifying tolerances for the outside diameter of plastics pipes shall be on the plus side in accordance with the formula $+x, -0$.

The test methods for plastics pipe shall be based on the following principles: 1) The tests shall be made on the pipes and not on the material. 2) The effect of time shall be taken into consideration. 3) The tests must be made on the pipes proper and not on specimens cut from the pipes.

The following test methods will be standardized: 1) Measurement of dimensions. 2) Bursting pressures after varying periods of time; the periods recommended were 10, 100, and 20,000 minutes. 3) Brittleness. 4) Resistance against flattening. 5) Resistance against kinking, especially when bent over mandrels of various diameters. 6) Internal stresses.

The following test methods are to be investigated by the Laboratories of the various member countries: 1) *Quality test:* Bursting pressures at 10, 100, and 20,000 minutes. 2) *Hydrostatic pressure test to be made by the*

(*To page* 296)

Table I: Minimum wall thicknesses for rigid polyvinyl chloride pipe

Outside diameter (d_o)	*Recommended minimum wall thickness for nominal pressure of:*		
	2.5 kg./cm.^{2}	*6 kg./cm.^{2}*	*10 kg./cm.^{2}*
mm.	*mm.*	*mm.*	*mm.*
5	1.0	1.0	1.0
6	1.0	1.0	1.0
8	1.0	1.0	1.0
10	1.0	1.0	1.0
12	1.0	1.0	1.0
16	1.0	1.0	1.25
20	1.0	1.0	1.6
25	1.0	1.25	2.0
32	1.0	1.6	2.5
40	1.0	2.0	3.15
50	1.1	2.5	4.0
63	1.4	3.0	5.0
75	1.6	3.5	6.0
90	2.0	4.25	7.1
110	2.25	5.3	8.5
125	2.65	6.0	10.0
140	3.0	6.7	11.2
160	3.35	8.0	12.5

This article is based on a report by W. Jansen and G. Ehlers in Kunststoffe 46, 281-282 (June 1956).



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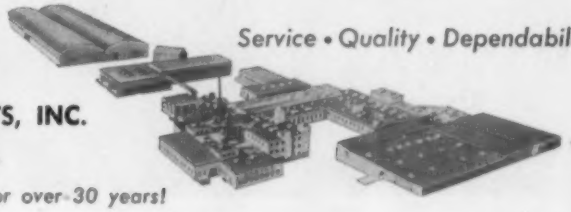
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Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Plastics as mechanical-engineering materials. J. A. Bjorksten. Mech. Eng. *78,* 337-40 (Apr. 1956). Plastics are highly adaptable materials covering a wide range of properties and fabricating methods. Complete freedom from corrosion can be obtained, and large or small objects of complicated shape can be formed in a single operation. Applications particularly adaptable to the use of plastics are discussed. The technique of supercooling is suggested to speed-up the production of plastic parts. Many plastics, if heated to near their melting point and then suddenly quenched, will remain soft, drawable, and formable for several hours to a day. The supercooling technique may prove particularly applicable to the rigid vinyls and to the new low-pressure polyethylenes. The reinforced plastics are particularly useful in making articles which have compound curvatures and which serve mechanical functions. Some properties of glass-reinforced phenolics, melamines, polyesters, and epoxies that are important in engineering design are listed. Examples of high-strength mechanical reinforcements utilizing synthetic fibers other than glass are also given. Factors involved in the machining of plastics are discussed.

New plastics molding materials. A. E. Javitz. Elec. Mfg. *57,* 90-101 (Mar. 1956). Current developments in plastics molding materials are reviewed, with emphasis on materials to meet specific and difficult performance requirements involving such properties as superior dimensional stability, high temperature resistance, wide-range thermal stability, corrosion resistance, and adaptability to full-scale automatic production techniques. Included in the discussion are the diallyl phthalate resins, the new epoxy molding powders, glass-filled phenolics, high-impact phenolics, moldable epoxy and phenolic boards, glass-silicone compounds, arc-resistant phenolics, silicone-bearing alloys, fluorocarbon elastomers, conductive plastics, and boron-base polymers.

Polyolefins: will three be a crowd? Chem. Week *78,* 79-80, 82, 84 (June 16, 1956). The possible commercial production of polypropylene is discussed.

Materials

Properties of Marlex 50 ethylene polymer. R. V. Jones and P. J. Boeke. Ind. Eng. Chem. *48,* 1155-61 (July 1956). Some of the important physical properties of ethylene polymers made by the high- and low-pressure processes are compared on the basis of crystallinity and/or density. The new Phillips low-pressure process is capable of producing a series of polymers whose properties span this density spectrum. One of the most interesting polymers of this series is Marlex 50, a high-molecular-weight, high-density homopolymer of ethylene. The physical, electrical, and chemical properties of this ethylene polymer are described, and various applications suggested by its properties are also indicated.

Molecular structure of Marlex polymers. D. C. Smith. Ind. Eng. Chem. *48,* 1161-64 (July 1956). Infra-red absorption, nuclear magnetic resonance, and X-ray diffraction techniques were used in a study of structural differences between conventional polyethylenes and those prepared by the new Marlex process. The former have significant numbers of short alkyl branches and a few internal olefinic structures that disturb the regularity of the chain and reduce crystallinity and density. In contrast, Marlex 50 polyethylene apparently has no branching and very few internal double bonds. Differences in olefinic structures in polyethylenes are significant and useful for purposes of characterization.

Flexible ferromagnetic plastics materials. W. J. Davis. Elec. Mfg. *57,* 131-33 (Mar. 1956). The properties and applications of a new ferromagnetic plastic material that is available in the form of flexible rod and flexible tape, as well as rigid powdered iron cores, are discussed. The flexible form is believed to permit the maximum utilization of the inherent magnetic properties of these materials and should make possible the design of smaller, highly efficient electronic components, including delay lines, transformers, inductors, and electromagnetic shielding. The ferromagnetic plastics are characterized by ability to operate continuously at temperatures up to 200° C., resistance to severe humidity conditions, very high impact strength, good machinability, high volume resistivity, and positive Q temperature coefficients.

Why there'll be more acrylic makers. Chem. Week *78,* 17-19 (June 2, 1956). Productions, both present and projected, for fibers made of acrylic plastics are discussed.

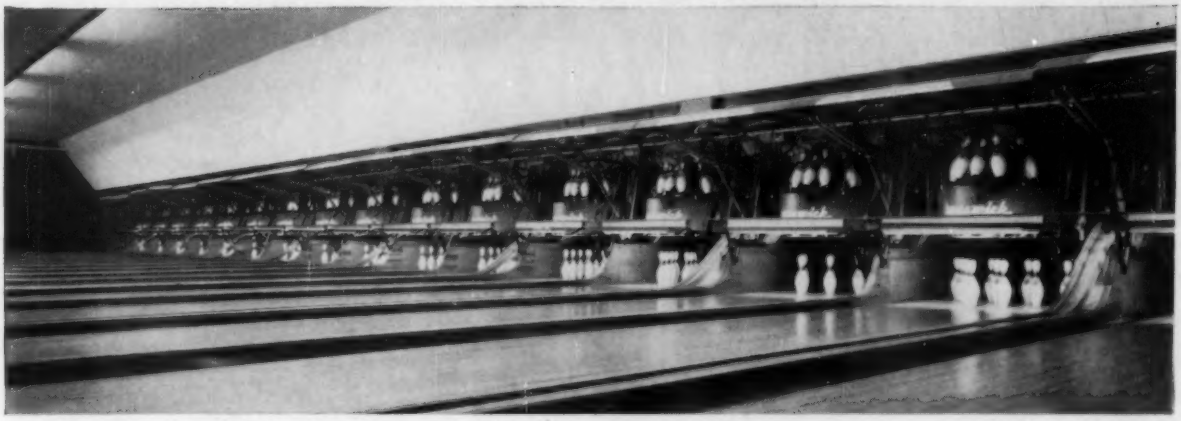
Preparing Teflon for bonding. Plastics Tech. *2,* 458 (July 1956). The surface of Teflon is treated with a bath containing metallic sodium and anhydrous ammonia to give a surface to which other materials will bond.

Molding and fabricating

A radically new press and mold for mass production of large plastics shapes. C. H. Van Hartesveldt. SPE J. *12,* 24-26 (July

*Reg. U.S. Pat. Off.

"Brunswick finds RCI resin right down its alley!"



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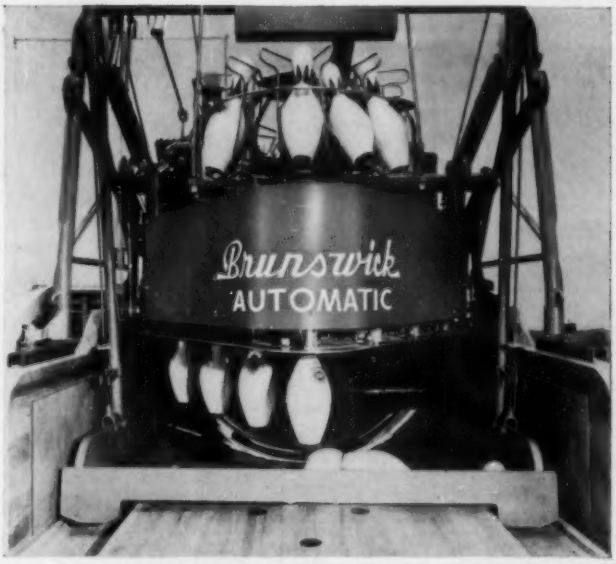
• The automatic pinsetter you see here increases the efficient operation of bowling alleys all over the country. Adds also to the fun and precision of the sport.

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1956). A radically new type of press and mold capable of mass production of large plastics shapes by process that can produce void-free fibrous glass-reinforced plastics moldings is described. The equipment costs less than that used in any other method.

Engineering of purchased molds. J. C. O'Brien. SPE J. *12,* 17-19, 49 (July 1956). Problems concerned with the engineering aspects of mold purchasing are discussed.

Single-screw extruders. E. G. Fisher. Plastics Inst. Trans. and J. *24,* 125-33 (Apr. 1956). The principle, design, types, and construction of single screw extruders are reviewed.

Multi-screw extruders. K. Baigent. Plastics Inst. Trans. and J. *24,* 134-41 (Apr. 1956). The design, flow pattern, efficiency, principle, and applications of multiscrew extruders are reviewed.

Design of vacuum evaporating plant for metallizing plastics. L. Holland. Plastics Inst. Trans. and J. *24,* 153-69 (Apr. 1956). The difficulties of using vacuum evaporation for the metal-finishing of plastics moldings are discussed in relation to the vacuum properties of the materials currently processed and the weaknesses in early vacuum systems. It is shown that deterioration in the pumping performance of a plant arises from contamination of the system by volatiles liberated from the plastics, and can be prevented by using an air-ballasted rotary pump and a "self-purifying" diffusion pump. Prolonged exhaustion during the "roughing" stage may be avoided by using a new type of vapor pump, termed a "booster" pump. Such a pump increases the pumping speed at intermediate pressures (0.01 to 2 mm. Hg), i.e., in the region of falling rotary pump speed. Booster pumps operate against a high backing pressure which permits a rise in the rotary pump "ultimate" pressure as occurs with air-ballasting. Maximum value from such a pumping system can be obtained by the operator ensuring that base lacquer coatings are fully stoved and avoiding the use of volatile plasticizers.

Applications

Techniques for using polytrifluorochloroethylene plastic in the chemistry laboratory. M. E. Runner and G. Balog. Analytical Chem. *28,* 1180-82 (July 1956). Apparatus made of a polymer of trifluorochloroethylene is very useful to the chemist in many cases where glass apparatus is unsatisfactory. A brief description of the useful properties of this plastic is given, along with some techniques of fabrication. A simplified technique for molding vessels from tubing is presented.

A potting compound and mold for precision pottings. W. H. Crandell. SPE J. *12,* 20-23 (July 1956). Addition of 200 parts per hundred of calcium carbonate of carefully controlled particle size (5 to 15 microns) to an epoxy resin with piperidine as a hardener produces a potting compound that does not stratify during cure and has good fluidity at 212° F. The compound when cured has a coefficient of linear expansion of 1.7×10^{-5}/°F. The coefficient of expansion can be varied by regulation of the amount of filler added. The cured units potted with this resin are resistant to cracking during cycling from —70 to 200° F., have good chemical resistance, and produce no volatiles on heating. Precision pottings have carefully controlled dimensions, no shrinkage, and complete impregnation of the item potted can be made using a modified transfer mold. The mold is made of a metal having a coefficient of expansion similar to that of the potting compound in order to allow easy ejection of the parts from the mold. A Teflon coating on the mold is recommended as a mold release.

Properties

Effects of explosions on plastics. H. A. Perry, Jr. SPE J. *12,* 13-16, 48 (July 1956). Plastic deformation under concentrated shock compressive loads is large in polyethylene, polystyrene, and cellulose propionate at elevated and room temperatures, and is small in ethyl celluose and the unmodified phenolics. Plastic deformation is perceptible in rubber-modified phenolics, cast polyesters, and polymethyl methacrylate. The phenomenon of multiple spalling, which had been observed in steel, was observed in plastics. The resistance to spalling of tire cord phenolics and ethyl cellulose is at least twice that of polymethyl methacrylate and perhaps four times that of the cast polyesters. The attenuation of compressive shock waves by polyethylene at all service temperatures, and by cellulose propionate and polystyrene at elevated temperatures, is considerable. On the other hand, ethyl cellulose and the unmodified phenolics are highly transmissive to shock waves. The retention of shape after spalling is good in the plastics that contain fibrous reinforcements, is fair in the softer thermoplastics, and is poor in the cast polyesters.

Water sorption in heat-treated polystyrene and plasticized polyvinyl chloride. A. G. Day. Electrical Research Assoc. Technical Report L/T344 (1956). Heat treatment of polystyrene is shown to increase the water sorption by about 20%. Tests on polyvinyl chloride at low humidities show a good correlation with the Brunauer-Emmett-Teller adsorption theory and provide theoretical confirmation of one of the constants. Activation energies for polyvinyl chloride are calculated and the temperature dependence of the isotherms is shown.

Irradiation of plastics. D. S. Ballantine. SPE J. *12,* 27-31, 49 (July 1956). The information available on the irradiation of plastics is summarized and reviewed. The underlying chemical reactions involved are discussed.

Effects of corona on plastic laminates. A. Rufolo and R. R. Winans. A.S.T.M. Bulletin No. 214, 53-56 (May 1956). A method of



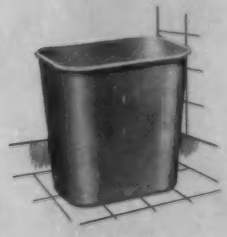
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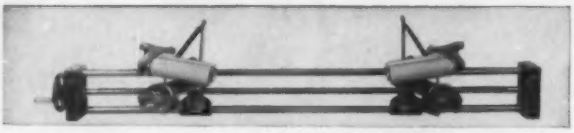
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corona exposure and exposure effects on various properties of materials are presented as a basic approach to the problem of corona deterioration in electrical equipment.

Testing

Proposed method of test for water vapor transmission of building materials utilizing the Penn State-Armstrong cell. A.S.T.M. Bulletin No. 215, 63-65 (July 1956). A method for determining the water vapor transmission of building materials is described.

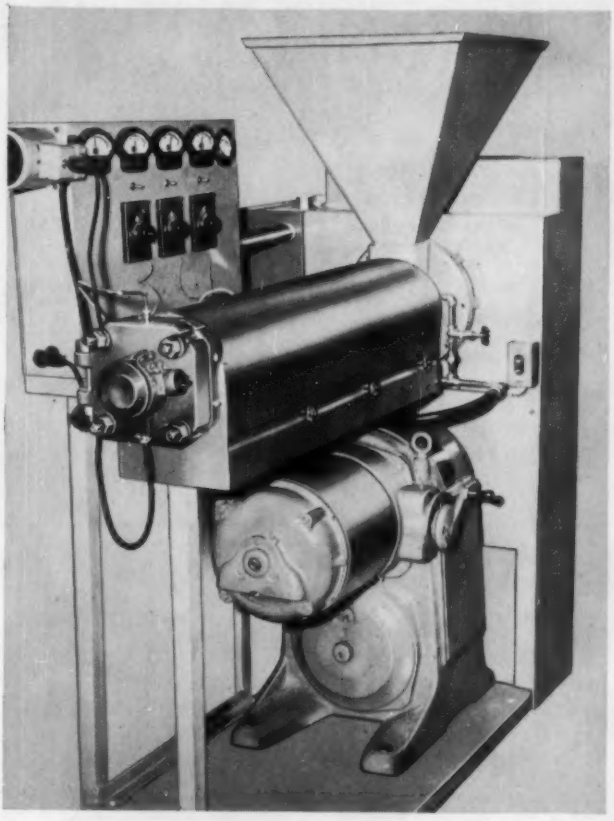
An apparatus for measuring the response of polymeric materials to an oscillating strain. B. Maxwell. A.S.T.M. Bulletin No. 215, 76-80 (July 1956). An apparatus is described for determining the real and imaginary components of the dynamic modulus and the mechanical loss factor over a wide frequency range under controlled conditions of temperature and strain magnitude. Results of tests with cellulose acetate, cellulose acetate butyrate, and polyvinyl chloride plastics are presented.

Index of refraction and particle size as factors in the infra-red spectrophotometry of polyvinyl chloride. M. R. Harvey, J. E. Stewart, and B. G. Achhammer. J. Research Nat. Bur. Standards *56*, 225-35 (Apr. 1956). The scope of solid-phase infra-red spectroscopy is broadened by the elimination of particle size restrictions heretofore placed on the sample. This applies only to samples whose indices of refraction change only slightly with change in wavelength and can be matched to the indices of refraction of the suspending medium. The potassium bromide pellet technique has been applied to the infra-red spectral measurement of relatively large, solid particles (up to 44 microns diameter) of polyvinyl chloride, thus providing a technique for obtaining the infra-red spectrum of polyvinyl chloride without subjecting the polymer to degrading forces. A near-match in the indices of refraction of potassium bromide and polyvinyl chloride is apparently re-

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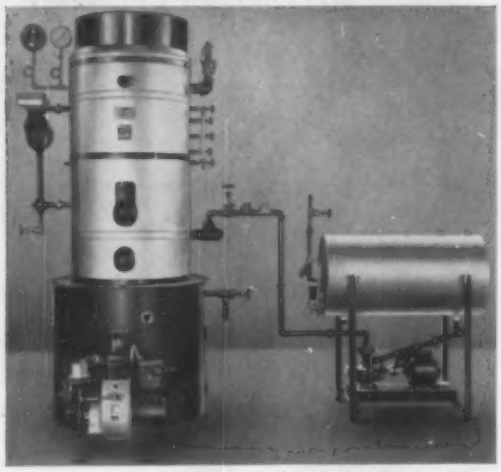
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sponsible for the well-resolved, scatter-free spectrum obtained. Other imbedding salts having different indices of refraction were used to demonstrate the necessity of matching the indices of refraction of medium and sample when the sample particles are relatively large. The measurement of potassium bromide pellets containing polyvinyl chloride of various particle sizes showed that even very large particles (up to 110 microns) will yield characteristic spectra when the indices of refraction of sample and medium are matched. Infra-red spectra of nylon and paper fibers imbedded in potassium bromide were obtained; these spectra demonstrate the feasibility of this method for use with other materials. Equipment developed to make suitable pellets is described.

Corrections

In the August issue of MODERN PLASTICS, p. 169, the publisher of the *Journal of Polymer Science* was incorrectly given. The correct name and address is: Interscience Publishers, Inc., 250 Fifth Ave., New York 2, N. Y.

In the article "Fluorocarbon coatings," beginning on p. 127 of the September issue, the incorrect address was given for Acme Resin Corp. The correct address is: Acme Resin Corp., 1401 Circle Ave., Forest Park, Ill.

Publishers' addresses

Analytical Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

A.S.T.M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.

Electrical Research Associates: The British Electrical and Allied Industries Research Association, Thorncroft Manor, Dorking Rd., Leatherhead, Surrey, England.

Industrial and Engineering Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Journal of Research of the National Bureau of Standards: Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Mechanical Engineering: American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

Plastics Institute Transactions: Plastics Institute, Aldelphi, Adams St., London W. C. 2, England.

Plastics Technology: Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.

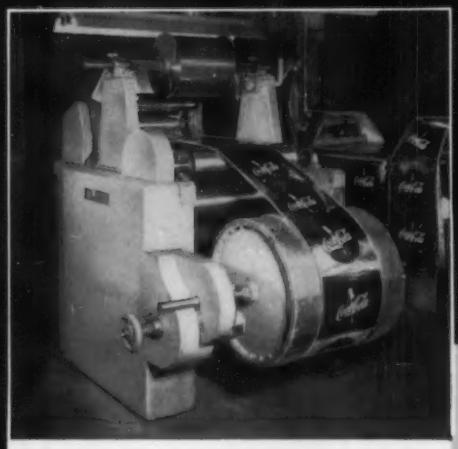
SPE Journal: Society of Plastics Engineers, Inc., 513 Security Bank Bldg., Athens, Ohio.

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U.S. Plastics Patents

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Vinyl polymer. M. Baer (to Monsanto). U. S. 2,750,351, June 12. Plasticized vinyl polymer.

Resin. R. J. Fanning and A. C. Dees (to Phillips). U. S. 2,750,352, June 12. Stabilized polysulfone resin.

Resins. S. B. Mirviss and F. W. Banes (to Esso). U. S. 2,350,353, June 12. Petroleum resins.

Resin. J. H. Merriam (to Allied Chemical). U. S. 2,750,354, June 12. Selective phenol-aldehyde resinifications.

Resins. H. P. Ledden (to American Cyanamid). U. S. 2,750,355, June 12. Melamine resins.

Resins. M. D. Hurwitz (to Rohm & Haas). U. S. 2,750,356, June 12. Urea-formaldehyde resins.

Resins. H. Brederick and E. Bader (to Deutsche Gold- und Silber-Scheideanstalt). U. S. 2,750,357, June 12. Polymerization process.

Resins. H. F. Park (to Monsanto). U. S. 2,750,358, June 12. Polyvinyl sulfonamides.

Hollow articles. C. C. Coates and J. D. Jackson (to Royal Manufacturing). U. S. 2,750,624, June 19. Machine for molding hollow plastic articles.

Molding. R. Colombo (to Royal Manufacturing). U. S. 2,750,625, June 19. Continuous molding of synthetic resins.

Molding. G. E. Henning (to Western Electric). U. S. 2,750,626-7, June 19. Extrusion molding.

Molding. W. S. Renier (to Giddings and Lewis). U. S. 2,750,628, June 19. Heating unit for molding machines.

Sheet. S. J. Johnson (to Clopay). U. S. 2,750,631, June 19. Ribbed extruded plastic sheet.

Surface reproduction. S. P. Kish (to Kish Plastic Products). U. S. 2,750,632, June 19. Plastic reproduction fixture.

Joint. C. M. Moore (to Moorex Industries). U. S. 2,751,109, June 19. Sealed structural joint in fiber-reinforced plastics.

Pipe fittings. E. E. Conley. U. S. 2,751,237, June 19. Fibrous glass-reinforced plastic pipe fittings.

Laminates. J. E. Pritchard and P. L. Q. Myers (to Phillips Petroleum). U. S. 2,751,323, June 19. Laminated products.

Elastomer. F. S. Martin (to U. S. Rubber). U. S. 2,751,363, June 19. Flock-filled isocyanate elastomer.

Polymers. R. R. Whetstone and J. R. Scheibli (to Shell). U. S. 2,751,-364, June 19. Polymers of unsaturated esters of cyclohexanecarboxylic acids.

Powders. J. F. Yost and I. B. Frederick (to American Cyanamid). U. S. 2,751,367-8, June 19. Friable polyacrylate powders.

Polymers. E. W. Taylor and C. C. Unruh (to Eastman Kodak). U. S. 2,751,372-3, June 19. Highly unsaturated isopropenyl acrylate polymers.

Polymerization. A. Cresswell (to American Cyanamid). U. S. 2,751,374, June 19. Polymerization of acrylonitrile.

Polymers. R. M. Mantell and W. S. Barnhart (to M. W. Kellogg). U. S. 2,751,375-6, June 19. Purification of fluorine-containing polymers.

Cellular bodies. H. Lindemann (to Lonza Electric and Chemical). U. S. 2,751,627, June 26. Producing expanded plastics.

Molded polymer. G. B. Carpenter, O. W. Fortner, and A. J. Buselli (to Air Reduction). U. S. 2,751,628, June 26. Molded acetylenic polymer.

Shaping. F. Dick (to R. A. Fisch). U. S. 2,751,629, June 26. Method of shaping plastic.

Molding compositions. N. S. Kuettel (to Curtiss-Wright). U. S. 2,752,315, June 26. Polystyrene molding compositions.

Polyvinyl chloride. P. H. Lipke, Jr. and R. S. Montgomery (to Dow). U. S. 2,752,316, June 26. Heat-stabilized polyvinyl chloride.

Polyesters. H. D. DeWitt (to Chemstrand). U. S. 2,752,320, July 26. Polyester compositions.

Tetrafluoroethylene. G. W. Heller (to Du Pont). U. S. 2,752,321, June 26. Lubricating and improving extrudability of polytetrafluoroethylene.

Polymers. A. B. Craig and G. E. Ham (to Chemstrand). U. S. 2,752,-324, June 26. Mixtures of acrylonitrile and alkenyl haloacetate polymers.

Stabilizer. W. E. Leistner and W. E. Setzler (to Argus). U. S. 2,752,325, June 26. Organic tin stabilizer for halogenated resins.

Stabilizer. R. E. Clayton, Jr. (to Esso). U. S. 2,752,326, June 26. Light stabilizer.

Resins. H. S. Bloch and R. B. Thompson (to Universal Oil). U. S. 2,752,327, June 26. Resins from aromatic polyketones and thio acid polyamides.

Polyamides. E. E. Magat (to Du Pont). U. S. 2,752,328, June 26. Polyamides of terephthalic acid and diamines.

Copolymers. A. L. Dittman, H. J. Passino, and W. O. Teeters (to M. W. Kellogg). U. S. 2,752,331-2, June 26. Copolymers of a perfluorochloroethylene and a fluoroethylene.

Mold. T. W. Winstead (to Hedwin). U. S. 2,752,632, July 3. Mold for thermoplastics.

Molding. E. W. Weitzel (to Western Electric). U. S. 2,752,633, July 3. Apparatus for advancing thermoplastic material in an extrusion machine.

Extrusion. B. M. Walker and L. W. Van Denburgh, Jr. (to Resistoflex). U. S. 2,752,637, July 3. Extrusion of polytetrafluoroethylene.

Polymerizing. H. D. Anspon (to General Aniline). U. S. 2,752,638, July 3. Polymerizing alpha-chloroacrylic acid esters.

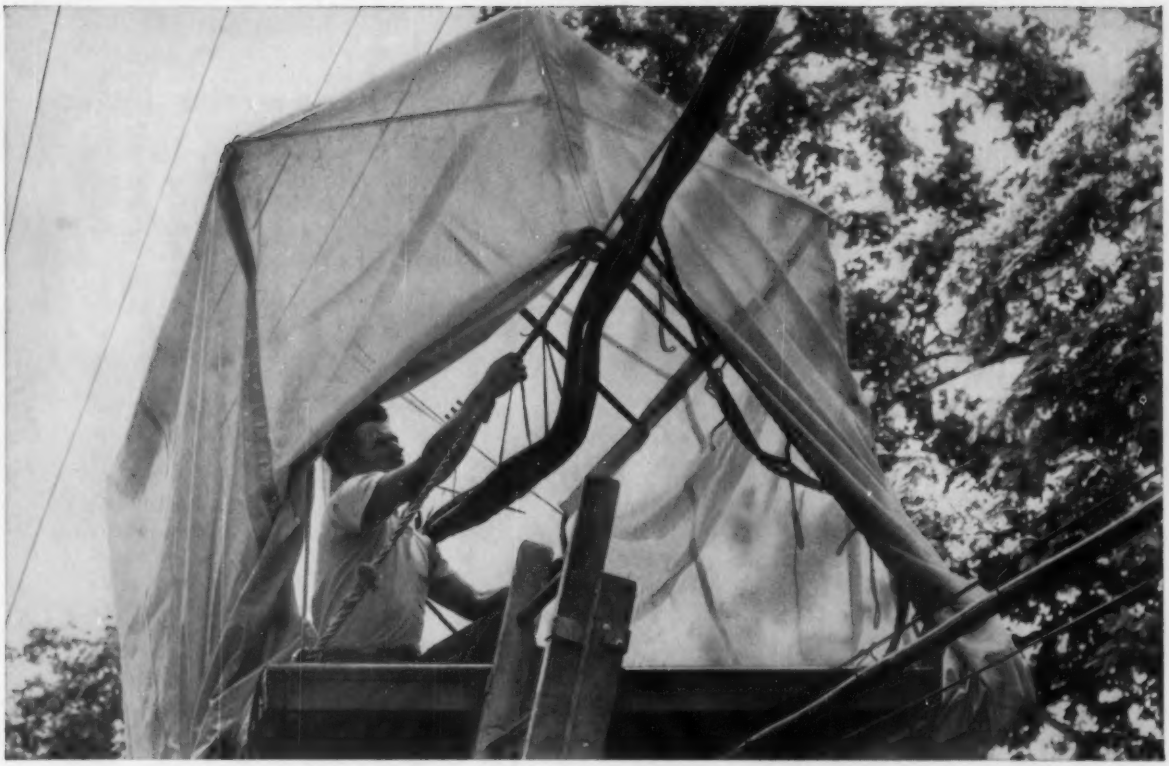
Coating. F. Brochhagen, B. Koln, P. Hoppe, and H. W. Paffrath (to Bayer). U. S. 2,753,276, July 3. Coating a surface with a foamed polyurethane.

Foam. V. L. Smithers. U. S. 2,753,-277, July 3. Urea-formaldehyde foam.

Molded articles. L. J. Miller (to American Hard Rubber). U. S. 2,-753,312-5, July 3. Resorcinol resin molding material.

Rubbers. C. E. Brockway (to B. F. Goodrich). U. S. 2,753,319, July 3. Cast polyurethane rubbers.

Resin. A. L. Jankins (to Dow). U. S. 2,753,321, July 3. Vinylidene chloride resin with improved color retention.



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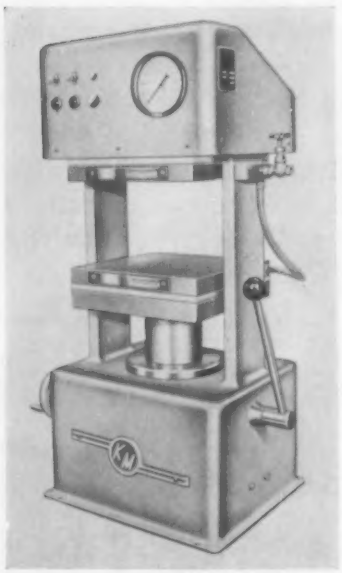
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A new one-color, gravure printing machine that will also do doctor-blade coating is designed for speeds up to 500 ft./min. Its features include: 1) the gravure role is easily emoved; 2) it has precision wedge steps with dial gages that indicate the closeness of contact in mils (or mm.); 3) impresssion pressure is controlled by an air cylinder, providing compensation for varying thickness of the web being printed. The machine is also equipped with a doctor blade and holder and a semi-enclosed pan, all made of stainless steel. *John Waldron Corp., New Brunswick, N. J.*

Compact portable potentiometer

A versatile little indicating potentiometer, the MiniMite, weighs less than 4 lb. and measures about 4 by 5 by 6 inches. Despite its small size, it has a scale 23.5 in. long, and so can easily yield precision readings. The MiniMite is built to accommodate either Iron-Constantan or Chromel-Alumel couples and has a double scale calibrated from 0 to 1800° F. for I-C and from 0 to 2400° F. for C-A. It can easily be read to within 1° F., but the accuracy is 0.25% of the scale range, or about 5° F. It can be used to measure temperature directly with any thermocouple circuit of reasonable resistance and it can also be used as a comparator for other kindred instruments. Voltage to the measuring circuit is supplied by an easily replaced mercury-cell battery. *Thermo Electric Co., Inc., Saddle Brook, N. J.*

Semi-permanent mold release

Spray Graph is a fast drying graphite lubricant, primarily intended to provide lubrication for the rubbing surfaces of both metallic and non-metallic parts. However, it has also been found effective as a mold release in sheet thermoforming, one application lasting for days. As a mold release agent it works best if it is polished to a high luster after being sprayed on. It adheres well to metallic and non-metallic surfaces at temperatures ranging from —100 to 800° F. *American Resin Corp., 3215 N. Sheffield Ave., Chicago 13, Ill.*

Cutting machines for plastics

Plastic-Master cutting machines have been especially designed for cutting all types of plastic films, coated fabrics, laminated fabrics, foams, etc. Through the use of selected motor speeds, special

Profitable Plastics Production with...

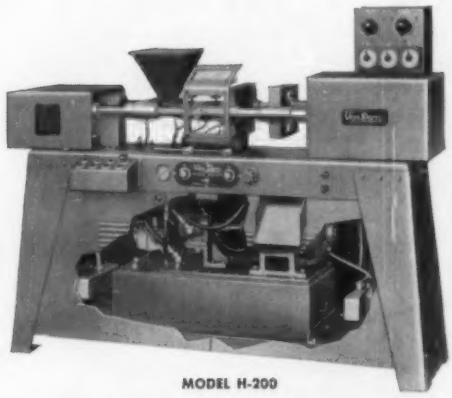
VAN DORN EQUIPMENT

AUTOMATIC OPERATION AT LOW COST

This high speed 2½ oz. injection press plasticizes material at 22 lbs. plus per hour, and attains up to 720 cycles per hour (dry run). High efficiency due to *water cooled* plunger, transfer hopper, and oil cooler. Accessible platen clamp device insures easy purging to change material. For safety, press will not operate unless part is fully ejected. Simple operation due to automatic, adjustable material metering device. Press requires little attention during production. May also be operated semi-automatically. All steel construction.



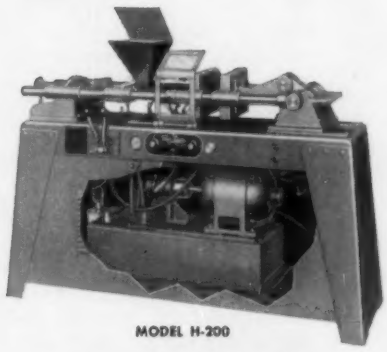
MODEL H-250



MODEL H-200

SEMI-AUTOMATIC 2 OZ. PRESS

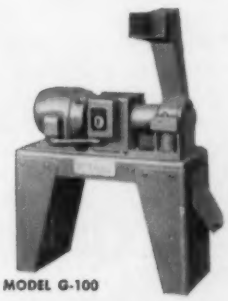
Up to 10 cycles per minute. Safe, simple push button controls. Accurate temperature regulation. Rugged, compact, quiet.



MODEL H-200

POWER OPERATED, LEVER CONTROLLED PRESSES

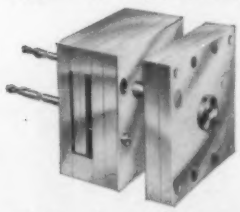
2 oz. or 1 oz. Operate 8 hours for under a dollar and use inexpensive molds. Easily set up in twenty minutes.



MODEL G-100

PLASTIC GRINDER

Grinds up rejects, waste, etc., for re-use. Ruggedly made, designed for easy cleaning.



MOLD BASES

Available from stock for all Van Dorn presses.

Write for Bulletins...Financing Available

THE Van Dorn IRON WORKS CO.

2687 EAST 79th STREET • CLEVELAND 4, OHIO

TELEPHONE: EN. 1-5234

sharpening elements, and high-speed steel knives, the marker claims to have overcome some of the more common difficulties of cutting these materials, e.g., fusing of edges due to overheating and sticking of materials to knife. In the straight-knife machines, offered in several sizes, the blade has a so-called "wave edge" from which some 80% of the cutting edge has been removed to minimize heat of friction. The round-knife machines do not have "wave edge" blades, but have many advanced features that make for trouble-free operation. *Eastman Machine Co., 779 Washington St., Buffalo 3, N. Y.*

Two-in. extruder

Outputs up to 90 lb./hr. are claimed for a new 2-in., single-screw extruder with a 3-section barrel; using all three sections, the barrel, from hopper to die, is about 40 in. long, thus meeting the increasingly popular standard of length: L/D=20. The 10-hp. drive offers four speeds over the range 17 to 109 r.p.m., with a 2-speed motor available as an extra. The barrel is heated by 12 band heaters that are operated by relays which in turn get their directions from barrel thermocouples. Except for radiation and convection to the surroundings, no provision is made to cool the barrel. Separate heat control is provided for the head and die. The standard screw, recommended for PVC, furnished with this extruder is cored for water along its whole length and needle valves provide close regulation of the water rate. Special screws are available on order. *W. S. Electronics (Extruders) Ltd., Brunel Rd., East Acton, London W. 3, England.*

Injection molding machines

The Lester "package maker" (see MODERN PLASTICS 33, 188, May 1956) is now being offered in four different filling speeds. The injection molding of thin-walled containers, where sections of fairly large area may be as thin as 15 mils, requires ultra-fast filling. Filling speed is the rate of cubic displacement at the top injection pressure, and is not to be confused with speed of dry-cycling, a no-pressure process. The L-2-4-oz. standard model can fill at the rate of 7.8 cu.in./sec. at a shot pressure of 20,000 p.s.i. The comparative specifications on all four models are shown in table below. *Lester-Phoenix, Inc., Cleveland, Ohio.*

Multi-barrel finisher

The Model MMB barrel finisher, described as a half-scale model of the maker's standard multi-barrel unit, can rotate as many as 10 finishing barrels at once. Barrels range from 3 to 8 in. in diameter and are mounted either square or at a 30° angle to the face of a vertically positioned rotating disk. The turning of the disk not only rotates the barrels fixed to it, but, when they are mounted at an angle, causes the barrels' contents to slide back and forth. This half-size (nearer ⅛-size, on a volume basis) unit is best suited to the finishing of relatively small quantities of small parts, such as those going into electronic gear, jewelry, cameras, etc. Clockwise and counterclockwise speeds range from 15 to 45 r.p.m. *BMT Mfg. Corp., 105 E. Ninth St., Elmira Heights, N. Y.*

Hopper loaders

The Aero-sonic, venturi-type loader is a portable device for transferring powdered and pelletized material from drums or bins to nearby feed hoppers. It will load from 200 to 600 lb./hr. of such material, with automatic self-control. Operated by air at from 20 to 60 p.s.i., depending on material density and rates, the



Rainville Aero-sonic portable loader can transfer 200 to 600 lb./hr. of material from drum to hopper

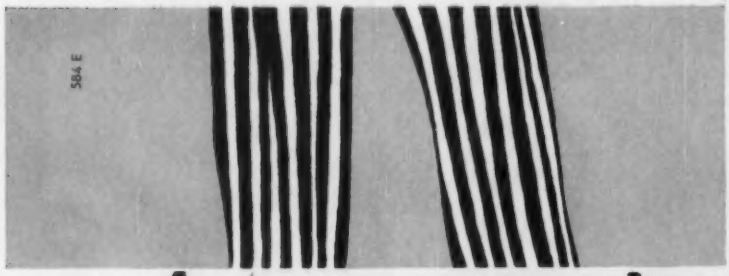
loader has a filter and water trap that help to prevent contamination of the powder during transport. No electric power is needed. Optional features are 1) an agitator that keeps the material supply free flowing to the loader intake, and 2) a timer and solenoid to control rates when they are below 200 lb./hr. The maker also offers a vacuum-type loader, electrically operated, particularly designed to handle dusty materials (molding powders tumbled with pigments, etc.) without getting dust into the working area. It, too, automatically controls its output. Compressed air is not used. *The Rainville Co., 224 Seventh St., Garden City, N. Y.*

Grained finishes

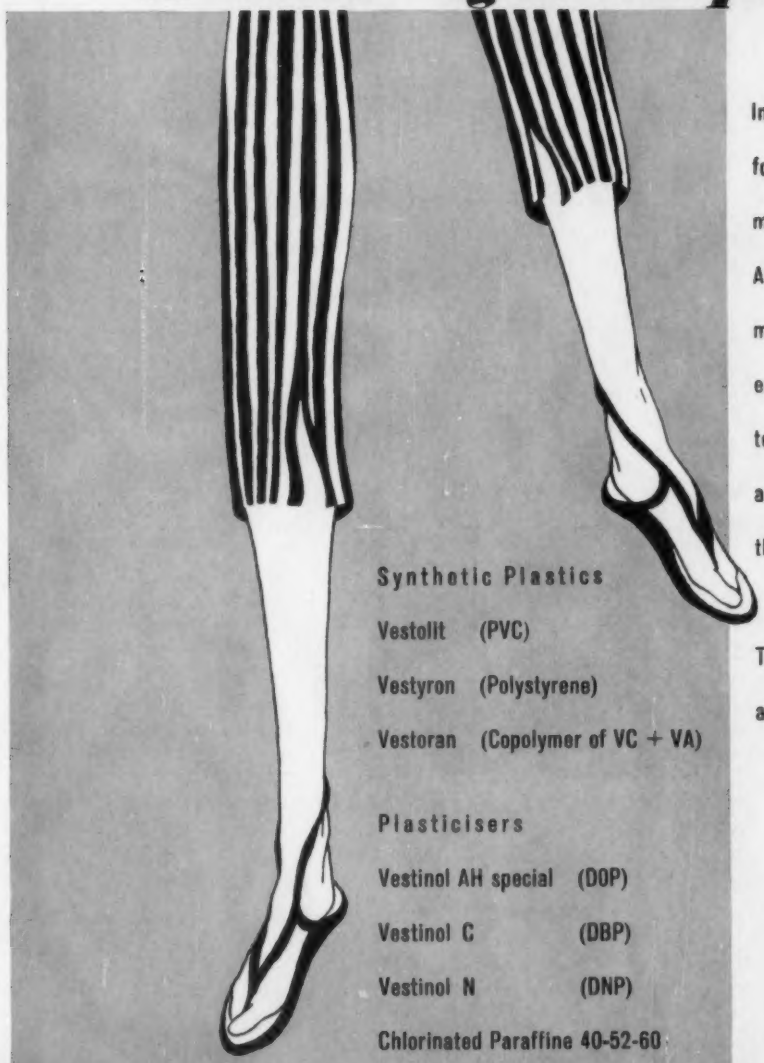
The Model V-27 graining machine, especially designed for makers of radio and TV cabinets, assembled furniture, etc., will print simulated wood grains on wood, steel, or plastics at speeds from 12 to 36 ft./min. or up to 400 cabinets per day. It can print

Specifications for Lester "package maker"

	Standard	Alt. A	Alt. B	Alt. C
Filling rate, cu. in./sec.	7.8	9.4	11.3	15.6
Shot press., 1000 p.s.i.	20	16	20	20
Clamping force, tons	125	90	125	125
Motor hp.	20	20	25	40



A teen-ager in plastics...



In 1938 Chemische Werke Hüls were founded and to-day they are one of the most modern chemical works of Europe. A teen-ager in years but a successful man in knowledge, experience and equipment. The enormous vitality of a teen-ager combined with the abilities and the scientific maturity of a man in the fifties make Hüls a good partner for all industries that need plastics. The plastic-rawmaterials from Hüls are o. k. It surely pays to write for further information.

Synthetic Plastics

Vestolit (PVC)

Vestyron (Polystyrene)

Vestoran (Copolymer of VC + VA)

Plasticisers

Vestinol AH special (DOP)

Vestinol C (DBP)

Vestinol N (DNP)

Chlorinated Paraffine 40-52-60

CHEMISCHE WERKE HÜLS
AKTIENGESELLSCHAFT
WESTERN GERMANY

PLANDEX "Hi-Quality"
Plastics Reworking Service
Turns Your Waste into Profit!

BLEEDER STOCK
CABLE STRIPPINGS
AND CUTTINGS—
Reprocessed
To Original
Extrudability

Thermoplastics
Restored
FOR REUSE IN
JACKETINGS AND
INSULATIONS

VIRGIN
MATERIALS
Compounded to
Your Recipe!

Turn your waste into valuable by-products the Plandex controlled quality way. Every job benefits from thorough experience, modern customized equipment including dual worm compounder-extruders and careful accurate interpretation of your specific requirements. We serve the industry's leaders throughout the U.S. and Canada.

Write for literature or sales engineering appointment.

PLANDEX
CORPORATION
DOWNINGTOWN, PA.
PHONES: 1419 OR 1438

three sides of a cabinet in 20 sec., will handle anything from 2-in. moldings to 40-in. cabinets. Powered by a ½-hp. motor, the V-27 is equipped with a 34- by 54-in. table and occupies 5 by 7 ft. of floor space. Oscillating doctor blades make cleaning fast and easy. *Hamant Tool Co., 3936 E. Second St., Dayton, Ohio.*

Electronic preheaters

The Reevelec self-contained plastics preheaters range in output from 2 to 6 kw., and are designed to handle both powder and preforms. These units feature extra-large platens covered with fibrous glass-reinforced silicones. Their top-opening ovens have internally counterbalanced lids, automatic timers, and safety features; shielding conforms to FCC regulations. *Reeve Electronics, Inc., 609 W. Lake Street, Chicago 6, Ill.*

Vacuum forming machine

A low-cost vacuum and drape forming machine has a 30- by 30-in. forming area and will drape draw to a depth of 16 inches. It is said to be simple and easy to set up for precision forming of all thermoplastic materials from 5 to 250 mils thick. The drape frame travels on ball-bearing ways,

(*To page* 231)



Kroll sheet forming machine has 30- by 30-in. forming area, can drape to a depth of 16 inches

MARKEM
solved these marking problems

marking fountain pen refill cartridges

Molding a red tip and imprinting cartridge proved costly, caused refill to warp. Markem was given the problem, devised method of simultaneously color-banding tip and imprinting instructions, using a Markem 20A machine. Costs now lower, production up, customer satisfied!



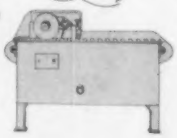
imprinting phono records

Eliminating all the problems — and expense — of paper label inventories and application, were the important benefits gained from the Markem Method. Standard 25A machines now imprint records directly — using Markem printing elements and Markem marking compounds to produce clear, high quality imprints.



printing hacksaw blades

Manufacturer needed a fast, economical way to mark complete detail on enameled hacksaw blades. For printing entire blades up to 30" long, at a rate of 30 per minute, a Markem 65A machine was recommended. Successful use resulted in purchase of a second Markem machine.



For product, part or package marking that tells and sells more for you, contact Markem Machine Co., Keene 20, N. H.

MARKEM ...TO MAKE YOUR MARK

Product-Building for Profits with Monsanto Plasticizers

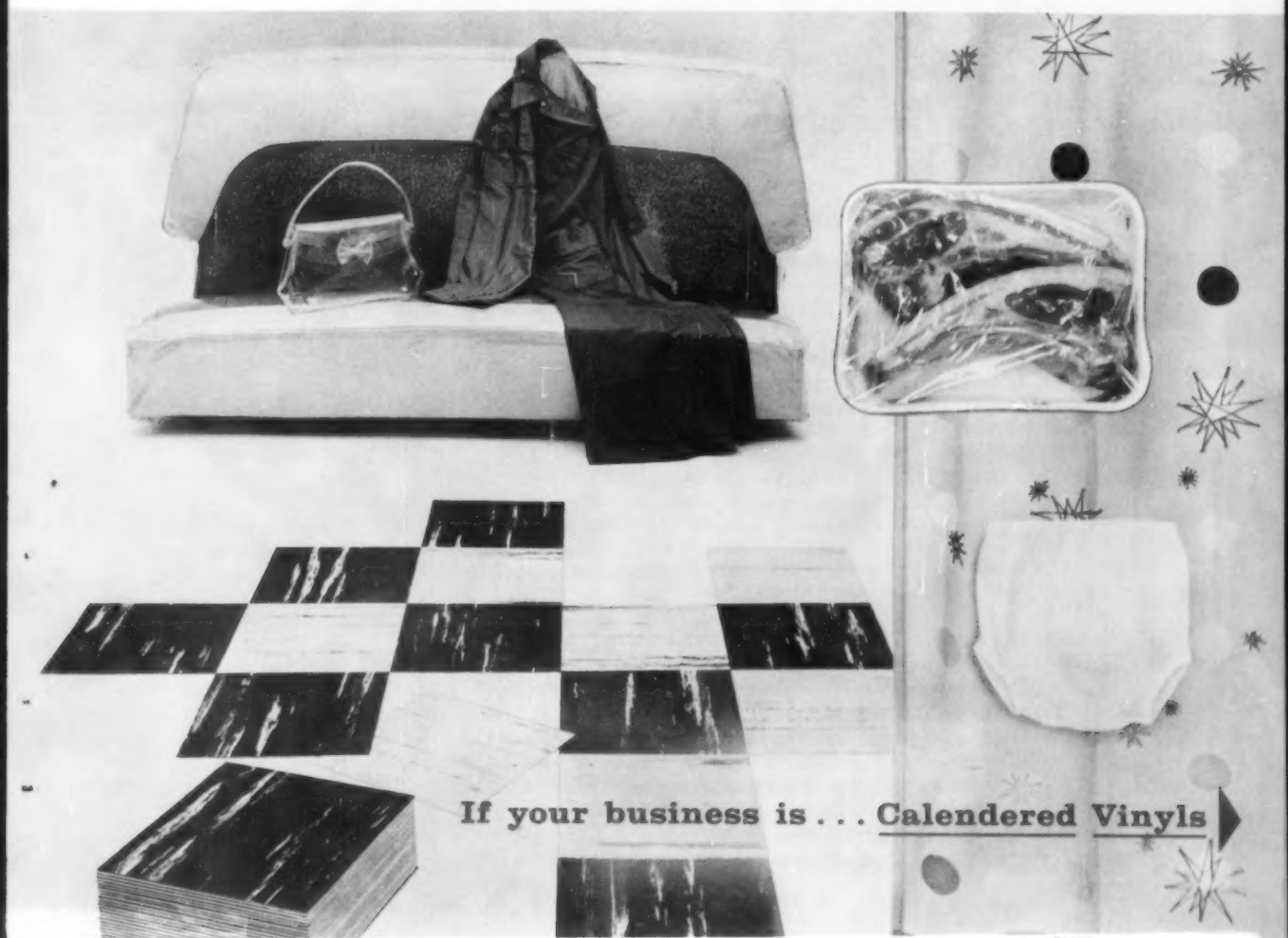
Your choice of plasticizers affects a wide variety of processing and end-product characteristics. The right plasticizer, or system of plasticizers, will help you avoid processing bottlenecks . . . can speed up production and cut your manufacturing costs.

Monsanto is America's most diversified manufacturer of plasticizers . . . originator of the industry's standard plasticizer, dioctyl phthalate . . . only source for chlorinated polyphenyls . . . supplier of SEVEN BASIC TYPES including almost FIFTY different types of plasticizers.

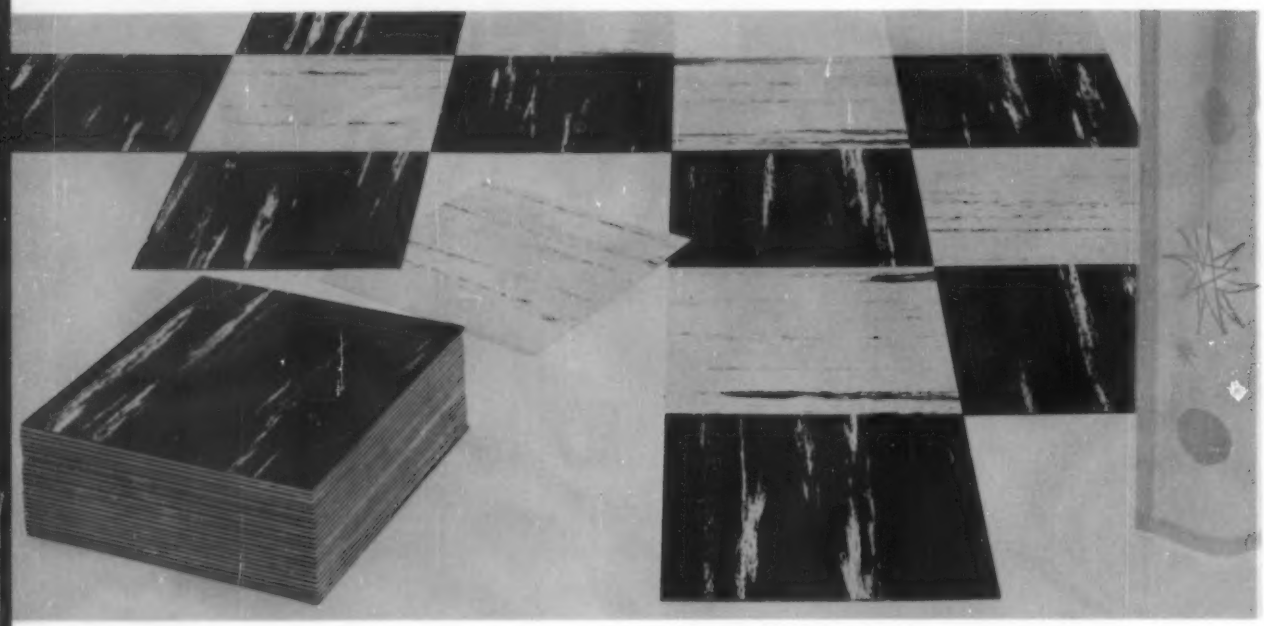
Call on Monsanto for one-stop service—mixed bulk shipments at bulk prices—expert technical guidance, formulating know-how for vinyls, cellulosics, styrenes, phenolics, melamines, ureas, epoxies.

"Plasticizers' Council Service". . .

For specific information on plasticizer systems to increase your processing efficiency or to improve your finished products, contact your Monsanto Sales Representative. He can offer you "Plasticizers' Council Service" on new products—or on established formulations—to help you solve formulating problems quickly and profitably.



You can build product quality, reduce costs of...



...Floor Coverings

Stain Resistance ... Nothing destroys a flooring material's appeal quicker than permanent stains that refuse to be wiped up—difficult food stains like mustard or catsup, ugly asphalt or tar stains tracked on by traffic, stubborn grease stains. Many product-wise manufacturers use Santicizer 160 in their formulations because they know Santicizer 160 offers more resistance to staining than any other monomeric or polymeric plasticizer—gives them extra assurance that their floorings will look better longer. *Important: Santicizer 160 is one of the most economical primary plasticizers on the market!*

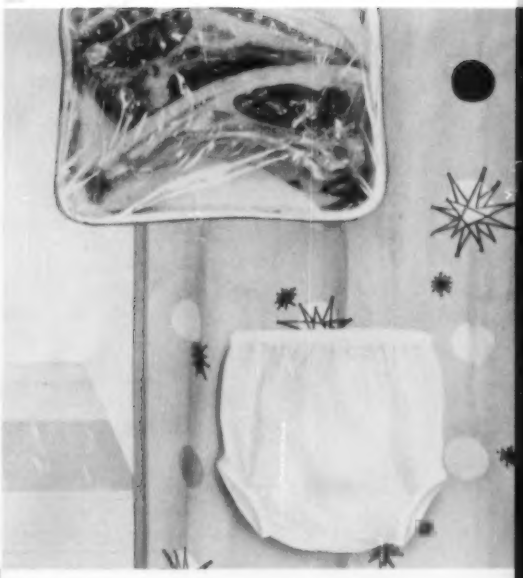
Faster Processing ... Fast-fusion plasticizers such as Santicizer 141, Santicizer 140, and Santicizer 160 help you cut processing costs by boosting rates of dry-blending, Banburying, milling, and calendering ... may also allow you to reduce power input requirements because they sustain fusion even at reduced temperatures. This is especially important in a process such as manufacture of vinyl-on-felt floorings, where heat must be reduced to avoid damage to raw materials. To know how Monsanto fast-fusion plasticizers can increase your processing rates, check typical (Banbury) fusion times in the table (above right).

Banbury Fusion Time Test

(50 parts plasticizer per 100 parts of resin)	Fusion Time (seconds)
Dioctyl phthalate	71
Santicizer® 141	49
Tricresyl phosphate	56
Santicizer 160	47
Santicizer 140	39
Polymeric "A"	106
Polymeric "B"	283

Higher Gloss ... a consumer appeal you can't ignore in vinyl flooring. Monsanto offers you *three* plasticizers—Santicizer 140, Santicizer 160, and Monsanto TCP—to improve gloss. They mean your floor tile will collect less dirt, clean easier, and need less waxing for that "like new" sheen.

Dimensional Stability ... How do you keep floor tile from changing its dimensions? One approach is to plasticize with *low-volatile* Monsanto DIDP. The best way, however, is to use fast-fusion plasticizers such as Santicizer 140 or Santicizer 160—to help prevent internal stresses during calendering that later result in dimensional changes. Ask your Monsanto representative for additional information.



Calendered Vinyls

. . . Vinyl Film

Non-Toxicity . . . Monsanto has pioneered in the development of non-toxic plasticizers for food packaging products. Santicizer 141 and Santicizer B-16 fully meet the requirements of both B. A. I. and F. D. A. You can use Santicizer 141 and Santicizer B-16 for aqueous, fatty, and non-fatty foods. Monsanto DOP and DIOP plasticizers are approved for vinyl film wraps for foods with high water content.

Soapy-Water Resistance . . . Monsanto DIDP resists the strong extracting action of soap and detergent solutions, and helps vinyl film products resist early discoloration, cracking, and other damage caused by frequent laundering. Test results (right) show how well Monsanto DIDP resists the extracting action of plain water, soap solution, detergent solution, and boiling water.

% Plasticizer Lost (in 24 hrs.)
(4-mil film, 45-p.h.r. plasticizer)

	Dioctyl Phthalate	Monsanto DIDP
Plain Water (50°C.)	0.44	0.25
1% Ivory† Soap (50°C.)	11.1	3.3
1% All* (50°C.)	1.45	0.1
1% Tide† (50°C.)	7.40	4.95
Boiling Water	12.9	9.0

†IVORY and TIDE Reg. Trademarks of Procter & Gamble Mfg. Co.

Tear Strength . . . Films plasticized with Santicizer 160 or Santicizer 141 may have as much as *double the tear strength* of those plasticized with straight dioctyl phthalate (right).

Elmendorf Tear Test on 4-mil Film
(50 parts plasticizer per 100 parts resin)

	Tear Strength (grams/mil)	
	Machine	Transverse
Dioctyl phthalate	185	275
Santicizer 160	425	555
Santicizer 141	435	530

Light Stability . . . In a recent outdoor exposure test, compounds (40-mil sheeting) plasticized with straight dioctyl phthalate failed in slightly over one year's exposure. Samples in which five parts of the dioctyl phthalate were replaced with five parts Santicizer 141 still have shown no visible deterioration—even after a total of *more than two years' exposure.*

. . . Vinyl Sheeting and Coated Fabrics



Less Migration . . . A small concentration of Monsanto HB-40* in vinyl formulations helps prevent "marring" or "lifting" of surfaces coated with nitrocellulose lacquers that come in contact with the vinyl. An added advantage of Monsanto HB-40 is its *low cost*—which makes it a money-saving replacement for part of the higher-cost primary plasticizers in your formulation.

Flame Resistance . . . Monsanto Santicizer 141 imparts flame resistance to sheetings and coated fabrics—also much-improved light stability, and resistance to weathering. Santicizer 141 reduces costs when you use it instead of more expensive phosphate esters, or antimony oxide.

Low-Temperature Flexibility . . . The volatility of Monsanto DIDA is only about one-third that of dioctyl adipate; it contributes the excellent low-temperature flexibility of the adipates, but with much lower volatility. *DIDA is economical—practically odorless—and you can use it to replace your present high-cost low-temperature plasticizer.*

*Reg. U. S. Pat. Off.

How buying from a one-stop source saves money

Case 1

Supplier		Three Suppliers—Three Shipments
A	DOP	5,000 pounds
B	TCP	5,000 "
Monsanto	Santicizer 160	10,000 "
		Total Cost $6,500 (LTL)
		One Mixed Truckload From Monsanto
Monsanto	DOP	5,000 pounds
"	TCP	5,000 "
"	Santicizer 160	10,000 "
		Total Cost $6,300 (TL)
		You Save $200 on 20,000 pounds

Case 2

Supplier		Two Suppliers—Two Shipments
A	DOP	10,000 pounds
A	TCP	10,000 "
Monsanto	Santicizer 160	10,000 "
		Total Cost $9,850 (TL & LTL)
		One Mixed Tank Truck From Monsanto
Monsanto	DOP	10,000 pounds
"	TCP	10,000 "
"	Santicizer 160	10,000 "
		Total Cost $9,150 (TT)
		You Save $700 on 30,000 pounds

Costs based on price schedules of February 15, 1956.

Monsanto Plasticizers

Phthalates
Dibutyl phthalate
Diethyl phthalate
Dimethyl phthalate
Diphenyl phthalate
Dioctyl phthalate
Diisooctyl phthalate
Di-n-octyl-n-decyl phthalate
Diisodecyl phthalate
Santicizer* 160
Santicizer 602
Santicizer 603
Santicizer 606
Santicizer 611
Santicizer 613

Adipates
Diisodecyl adipate
Dioctyl adipate

Phosphates
Tricresyl phosphate
Triphenyl phosphate
Santicizer 140
Santicizer 141

Phthalyl Glycolates
Santicizer E-15
Santicizer B-16
Santicizer M-17

Sulfonamides
Santicizer 1-H
Santicizer 3
Santicizer 8
Santicizer 9

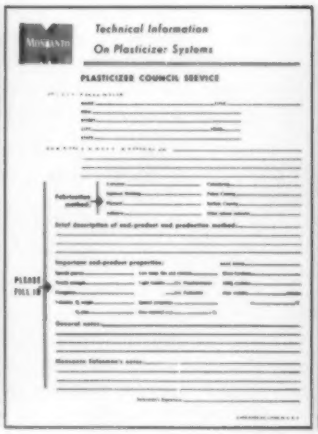
Sulfonamide Resins
Santolite* MHP
Santolite MS-80%

*Reg. U. S. Pat. Off.

Specialties
HB-40*
HB-20*
Santowax* R
Aroclor* 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Aroclor 4465
Aroclor 5442
Aroclor 5460
Aroclor 2565

For Formulating Guidance . . .

Your Monsanto representative will help you get quick and profitable guidance for improving your raw material mix, speeding up processing, or improving your products. Ask him to help you fill out a "Plasticizers Council" request-card, and submit it for technical group guidance. Ask him for an extra supply of request-cards for future use.


Technical Information
On Plasticizer Systems
PLASTICIZER COUNCIL SERVICE

Monsanto Chemical Company,
ORGANIC CHEMICALS DIVISION,
Dept. PL-3, Box 478,
St. Louis, Missouri

MONSANTO ®

assuring accurate positioning and good reproducibility. The machine occupies a floor area 32 by 32 in. and stands about 8 ft. high. Selective spacing of heater rods gives uniform heating of the sheet over its whole surface. *Kroll Equipment Co., 620 W. Fulton St., Chicago 6, Ill.*

Hydraulic press controller

The E364 Robotron Control is a completely packaged unit that will automatically close a hydraulic press, freeze the mold at the right time, relieve gases by "bumping" at intervals, etc. Some advantages are: cycles must be reset in a few seconds, the operating pushbuttons are located on the case, and the solenoid-operated air valve is within the case. All relays are of the plug-in type for easy checking and servicing, and are completely enclosed. The timing motor itself is a plug-in unit, making possible quick changes from one timer range to another. *Emmett Machine and Mfg. Inc., 445 E. Turkeyfoot Lake Rd., Akron 19, Ohio.*

Hole detector

A new instrument for controlling quality of film is the Viking hole detector. The standard model tests non-conducting materials up to 25 mils thick and detects holes 15 mils in diameter and larger at film speeds up to 1500 ft./min. With a 2- or 3-position recorder, the holes are not only recorded and counted, but located. Twenty-four-hr. recording equipment may be connected if desired. *Viking Instruments, Inc., East Haddam, Conn.*

Interchangeable, lightweight sleeves for printing rollers

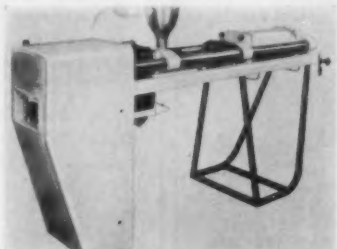
Rubber-faced design rollers for flexographic printing of continuous over-all designs are now available as lightweight, slip-on "D-Mount" sleeves. Made of a light-metal alloy, the sleeves are designed to fit interchangeably on a special shaft built to insure very close tolerances on lateral placement and concentricity. Disassembly is simple, permitting rolls to be stored while the shaft is in use with another roll. The rubber printing surface is molded to the customer's design and vulcanized to the metal backing. Available for single- and multi-color designs in face sizes up to 90 in. and diameters up to 9 in., D-Mount rollers cost less than integral-shaft rollers, weigh only 1/10 as much. *Mosstype Roller Co., Inc., Waldwick, N.J.*

Deburring machine

A small machine designed to deburr the plane faces of cylindrical parts can handle some parts at very high rates (e.g., 3000 plastic washers per hr.). A hopper-feeder positions the parts so that the face to be deburred faces upward. An air-operated vise holds the piece while a drill-head feeds, machines, and retracts. The part is ejected and the next one is positioned. *The Klaas Machine and Mfg. Co., 4314 East 49th St., Cleveland 25, Ohio.*

Automatic transfer press

The Model 99-A fully automatic transfer molding press is particularly well suited for getting into production quickly and at low cost, on low-quantity runs, and for economical molding of small parts. Air-operated, the press requires a 1/3- to 3/4-hp. air supply at 80 p.s.i. Transfer pressure is adjustable to 9000 p.s.i., while the clamping capacity is 15 tons. With a 2-cavity mold, maximum part dimensions are 1.2 by 1.2 by 0.9, but only 0.9 cu. in. of material can be shot in one stroke. The press requires 110-v., 15-amp., 1-phase a.c. for its heaters and controls. It can be fed general-purpose thermosetting molding powders; no preheating is necessary. Once in operation, the press needs only to have its hopper refilled



Hull Standard Model 99-A automatic transfer press has transfer pressure adjustable to 9000 p.s.i.

*Reg. U. S. Pat. Off.

In Wood Flour Security of Supply is Vital

Security of supply is a vital consideration in selecting a source, or sources, for wood flour. One reason is the combustible nature of wood flour during milling.

Wilner has two wood flour plants — completely separated — completely redesigned and rebuilt in 1951 — each plant safety engineered from the ground up.

In addition, the Wilner Company controls its own raw materials and its transportation, with elaborate rail facilities and its own fleet of trailer vans, to assure dependable deliveries under any conditions.

Typical Analysis 60 Mesh Wood Flour

Thru	On	%
	60	0
	80	2
140		76.8

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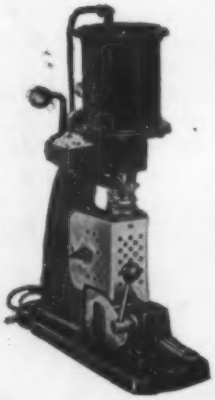
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Ideal for—

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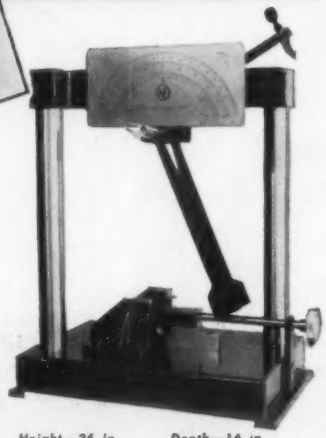
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- Combined Izod and Charpy.
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Mass is properly concentrated close to the impact point. Hammers are integral with bits, have no screwed-on ballast weights or adjustable parts.

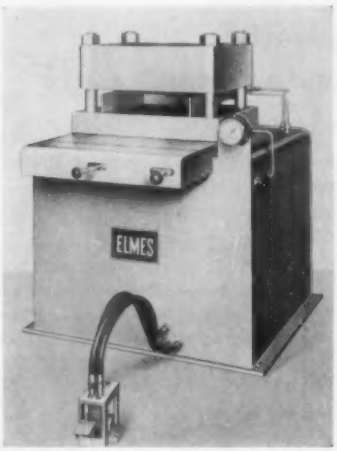
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TESTING MACHINE DIVISION

and the finished parts removed occasionally. It has been thoroughly checked out in the field (the operation of a battery of similar presses was described in MODERN PLASTICS 33, 155, May 1956). *Hull-Standard Corp., Abington, Pa.*

Press works off shop air line

Hydrolair presses are motorless, pumpless hydraulic presses that get their power from the regular shop air line (see MODERN PLASTICS 33, 164, Feb. 1956). The new model has a downward closing platen and a built-on work table at the level of the press bed. The



Elmes Hydrolair pumpless press gets power from regular shop air line

press has a 50-ton capacity and needs an air supply of about 80 to 90 p.s.i. It is available with or without hot plates, and with manual or electrical controls. *American Steel Foundries, Elmes Eng. Div., 1150-B4 Tennessee Ave., Cincinnati 29, Ohio.*

Beta-ray gage

Like other beta-ray gages, the Betameter uses beta radiation absorption to measure the mass per unit area of sheet materials. An exclusive feature of the new instrument, claimed to give greater stability and accuracy, is its null-balance operation. It provides continuous standardization, cancelling out such factors as the gradual decay of the radioactive source, etc. *Isotope Products, Inc., 1700 Niagara St., Buffalo 7, N. Y.*



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Why 402 U. S. manufacturers now enjoy 100% tax



Governor Muñoz tells why Puerto Rico offers such amazing incentives to new or expanding manufacturers.

"IN THIS statement, I shall try to explain Puerto Rico's economic position as frankly as I would to any manufacturer or labor leader who met me face to face.

Puerto Rico is currently making a determined effort to stand squarely on its own economic feet. At present we do not have nearly enough jobs to support our people. We are therefore directing every energy to create more jobs at home, and to curtail migration to the States.

That is precisely why we are going all out to attract every *new* plant we possibly can. But, to date, we are still providing only 25% of the new jobs we need *each year* to keep pace with our expanding labor force. I shall go into details later. But first I want to make two points of my Government's policy absolutely clear:

> **1. Puerto Rico has no intention of winning industries *away* from anywhere. We do not grant tax concessions to *runaway* plants.**
>
> **2. Puerto Rico's Industrial Development Plan is based on a combination of absolutely ethical incentives. We do *not* and *never will* hold out low wages as an attraction to business. My Government's firm philosophy is that wages should rise as rapidly as our economic development permits.**

Let me now describe our basic problem in more detail."

Our Problem

"When people talk of over-population as Puerto Rico's biggest headache, they certainly don't exaggerate.

Our unemployment is high. Our income level is still low—only 25% of the U. S. average. And every year 20,000 more workers swell our under-employed labor forces.

But this is probably putting the cart before the horse. Our real problem is not over-population but *under*-development. What then is our best solution?"

Our Solution

"I am convinced that the answer can only lie in more and more industry. Hence we are pinning our major hopes on our industrial development program, as the main pull of what we call Operation Bootstrap.

From the economic standpoint, Operation Bootstrap has but one simple aim—to develop industry, and in doing so, to encourage U. S. manufacturers to *expand* their operations to Puerto Rico. Operation Bootstrap is, in fact, a bold attempt to increase the well-being of our whole Commonwealth—workers and employers alike. And lest anyone should fear that my country's program might injure the U. S. economy, let me now sound a reassuring note:

> **1. The U. S. already has 65 *million* employed. Puerto Rico only needs to create 150 *thousand* new jobs to solve its present problem.**
>
> **2. One half of one percent of normal U. S. industrial *expansion* would achieve our whole economic program.**

I hope these comparisons help to put Puerto Rico's modest needs in proper perspective. But, for good measure, let me quote a few more figures to show how important a prosperous Puerto Rico is to U. S. business itself:

> **In 1955, Puerto Rico's purchases from the U. S. rose to $580,000,000. *Without* Puerto Rico as a customer, New York's gross sales would have dropped by $67,000,000; California's by $54,000,000; New England's by $53,000,000.**

So much for statistics. Now just a word about my people, without whose willing co-operation Operation Bootstrap would merely be a sterile dream."

Bootstrap Underway

"Pay us a visit and I think you will be impressed immediately by the wholehearted faith we Puerto Ricans place in Operation Bootstrap.

We believe in it deeply and thoroughly—and, with practically no exceptions, support its policies right along the line. Thus, I can promise the same eager, cheerful co-operation to every U. S. manufacturer who expands his industry to our Commonwealth.

Scarcely a month goes by that I am not visited by the Mayors of a dozen Puerto Rican towns, all asking for plants to be erected in *their* areas. There's not a community in all Puerto Rico that would not enthusiastically welcome the arrival of a new factory.

For we all realize that though we have made a promising start up the long, long hill to economic prosperity—the summit is not in sight yet. But the Puerto Rican people have squared up to their challenge and are meeting it in good heart."

in Puerto Rico freedom

Corporate Tax Exemption

If your net profit after U. S. Corporate Income Tax is :	Your net profit in Puerto Rico would be :
$ 29,500	$ 50,000
53,500	100,000
245,500	500,000
485,500	1,000,000

Dividend Tax Exemption*

If your income after U. S. Individual Income Tax is :	Your net income in Puerto Rico would be :
$ 7,760	$ 10,000
15,850	25,000
25,180	50,000
51,180	200,000

*Dividends are tax-free only if paid to residents of Puerto Rico by a tax-exempt corporation. Examples are based on Federal rates (Jan. 1, 1956) for single persons.



Beardsley Ruml tells how new or expanding industries (not runaway plants) get tax exemption.

"START A NEW plant in Puerto Rico and you are not only free from Federal income taxes (they don't apply)—you can be exempt from *local* income taxes too. Your freedom from Federal taxes is *not* a concession. It is a *Constitutional* fact which stems logically from that historic American principle 'Taxation without representation is tyranny.' Puerto Rico has no vote in Congress, and therefore no Federal income taxes—corporate or personal."

Protected by Two Constitutions

"Your business is not only protected by the Commonwealth Constitution, it is permanently guarded by all the guarantees of the U. S. Courts and Constitution, too.

As for your *local* income tax exemption, this is an *added* incentive, offered by the Commonwealth Government to attract new plants that Puerto Rico's economy needs so urgently."

How you gain from a new plant in Puerto Rico

1. A better return. Local tax concessions, freedom from Federal taxes, and lower operating costs will all reflect favorably in your company's balance sheet. See table above.

2. Abundant, skillful labor. Puerto Rico's labor force totals 644,000. The Commonwealth operates an ambitious vocational training program, which will even screen workers and teach them *specially* to operate your machines. The adeptness of the Puerto Rican worker in learning precision skills may be judged by the fact that the following famous companies now have operations in Puerto Rico:

Remington Rand. St. Regis Paper. Beaunit Mills. International Latex. Carborundum Company. Shoe Corporation of America. United Drill and Tool. Sunbeam Electric. Univis Lens. Weston Electrical Instrument Company.

3. No currency or customs problems. Puerto Rico is a Commonwealth freely associated with the United States. It is an integral part of the U. S. economic system. You have none of the problems of operating from a foreign country. Movement of goods, money and people between Puerto Rico and the U. S. is as free as it is between the states of the Union. There's no duty on trade and the U. S. dollar is currency.

4. Low capital investment. New single-story, low-rental factories are ready to occupy. The government will even build a *special* one for you on a very small down payment. Abundant electricity, gas and water are just waiting to be connected.

5. Ideal location. Puerto Rico is served by 30 ocean lines and 8 airlines. It is only 5½ hours by air from New York—less than 4 from Miami. Goods are actually made in Puerto Rico one day and are delivered in Los Angeles the next. The climate is perpetual Spring. Temperature stays around the balmy 70's most of the year. Swimming, sailing and fishing are superb. Domestic help is plentiful.

Is Your Company Eligible?

To find out if your company is eligible for tax exemption in Puerto Rico, call our nearest office:

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Chicago ..... AN 3-4887 ... 79 W. Monroe
Los Angeles ... WE 1-1225 ... 5525 Wilshire

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Dept. MP-62

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Product _____

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Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Chemistry of High Polymer Degradation Processes"

By Norman Grassie
Published in 1956 by Interscience Publishers, Inc., 250 Fifth Ave., New York, N. Y. 335 pages. Price: $6.50.

Degradation reactions are classified into those induced by physical agencies, such as heat and light (depolymerizations), and those induced by chemical agencies. The first third of the book is devoted to such reactions. The next four chapters deal with hydrolysis and related reactions, oxidation, sulfuration and ozonization, and reactions of chain substituents, etc. The author says that "This book is . . . addressed to three distinct groups of chemists." First are the polymer chemists; next are the industrial workers, to provide a guide to their knowledge of weathering and deterioration; and third are those chemists with a general interest in the kinetics of chemical change. There are over 400 literature references up through 1954, and a nine-page index.

"The Mechanical Properties of Textile Fibers"

Edited by R. Meredith
Published in 1956 by Interscience Publishers, Inc., 250 Fifth Ave., New York, N. Y. 333 pages. Price: $8.75.

One of a series of monographs on rheological behavior of natural and synthetic products, this work is divided into three main sections—1) cellulose fibers, 2) protein fibers, and 3) synthetic fibers—preceded by an introductory chapter on the general structure of fibers and their mechanisms of deformation. The introduction and the section on protein fibers were written by L. Peters and H. J. Woods, the sections on cellulosics and synthetics by Mr. Meredith. The editor's objective was to provide an up-to-date summary of the experimental and theoretical work done during the last decade on the mechanical behavior of fibers. While this seems to have been accomplished, the scope of the work is really much wider: it also includes the valuable contributions from earlier work. Each of the three main sections is divided into chapters on structure, tensile behavior, equilibrium and kinetic theory, creep and relaxation, and dynamic mechanical properties. There are over 220 literature references through 1955, and a nine-page index.

"The Development of Markets for New Materials"

By E. Raymond Corey
Published in 1956 by Riverside Press (Harvard University), Cambridge, Mass. 265 pages. Price: $4.00.

Essentially a case study and analysis of the development of markets, the text of this book covers plastics, fibrous glass, and aluminum. Its avowed purpose is threefold: to describe in some detail efforts to build markets for materials by developing markets for new end products made from these materials; to identify the characteristic marketing problems; and to study approaches to these problems. Many of the problems connected with the plastics industry are covered.

"Der Spritzguss Thermoplastischer Massen"

by Dr. M. E. Laeis
Published in 1956 by Karl Hanzer Verlag, Leonhard-Eck Strasse 7, Munich 27, Germany. 301 pages. Price: 29 DM (ca. $7.25).

According to the author, this is the first comprehensive volume published in the German language on the subject of injection molding. The text covers historical development, components of injection machines and their functions, injection molds, characteristics of plastics materials that can be injection molded (general and specific), design of molded pieces (wall thicknesses, corners, holes and slits, etc.), and areas of application of injection molded articles; also included are listings of manufacturers of injection molding machines throughout the world (including machine capacity), statistics, literature references, and patent information. The book contains 180 illustrations.

Injection machine. Bulletin 565 gives specifications, design features, and advantages of a 2-oz. automatic injection molding machine (see MODERN PLASTICS 33, 162, July 1956). 8 pages. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia, Pa.*

Plasticizer. Bulletin R-11 lists properties and briefly describes applications of a new petroleum-based plasticizer for both natural and chemical rubber stocks. Companion bulletin R-12 reports results of laboratory tests undertaken to determine the relative properties of natural rubber smoked sheet tread stock containing the new plasticizer and similar stock compounded with pine tar. *Witco Chemical Co., 122 E. 42 St., New York, N. Y.*

Chemical engineers. Brochure outlines engineering and consultancy services offered to the chemical and petroleum industries. Examples of designed, engineered, and erected plants are shown. 4 pages. *Petrocarbon Developments Ltd., 17, Stratton St., London, W. 1, England.*

Injection machine. Bulletin 627-B describes the operation of vertical injection molding machines available in 1-, 2-, 6-, 16-, and 24-oz. sizes. Advantages of the vertical method, specifications, and dimensions are given. 8 pages. *Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., 109 Aldene Rd., Roselle, N. J.*

Process equipment. Dry-blending and heat-transfer equipment for the chemical and process industries are described in revised catalog #14. Performance data,

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operating principles, specifications, etc., are included. 16 pages. *Patterson-Kelley Co., Inc., East Stroudsburg, Pa.*

Resin-coated sand. Booklet outlines various methods by which sands can be coated with resins for use in shell molding. Typical formulations are given. 18 pages. *Durez Plastics Div., Hooker Electrochemical Co., Walck Rd., North Tonawanda, N. Y.*

Pigment dispersion. Technical data bulletin presents formulation data, in 16 different product classifications, covering a line of plastics pastes and chips in various vehicles. Also included is information on colorants for plastics, and products for transparent coatings. A concluding section gives hints for mixing. 4 pages. *Pennsylvania Color & Chemical Co., Pine Run Rd., Doylstown, Pa.*

Melamine, urea. Set of bulletins gives descriptions, technical details, recommended mixtures, working life, pressing times, etc., for a line of urea and melamine cements, adhesives, and hardeners; other available bulletins present information on properties of urea and melamine molding powders, molding conditions, cure, preheating, etc. *B.I.P. Chemicals Ltd., Popes Lane, Olbury, NR Birmingham, England.*

Radiation-convection. Catalog explains the latest techniques used in process heating, including a method of combining radiation with convection. Advantages, applications, and information on panel segments, wiring, etc., are included. 16 pages. *Jensen Specialties, Inc., 9331 Freeland Ave., Detroit 28, Mich.*

Information sheet. Vol. 1, No. 1 of a bi-monthly publication explains its function of supplying information about plastics developments taking place at *Plastic Age Sales, Inc., 651 Arroyo Ave., San Fernando, Calif.*

Printed circuit tolerances. Technical bulletin P-9 lists diameter tolerances of unplated and plated holes, location tolerances between holes, hole-to-hole pattern tolerances, alignment (front to back) tolerances, circuit pattern to outside dimension tolerances, plating tolerances, etc., all having to do with design and production specifications of printed circuitry. 2 pages. *Photocircuits Corp., Glen Cove, New York.*

Extrusion compounds. Properties, composition, and advantages of eight typical compounds for extrusion based on polyvinyl chloride polymer are listed in technical Bulletin 5-C-1. 4 pages. *Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio.*

Lauric acid. Technical data sheet gives specifications, composition, and packing information for lauric acid, a fatty acid derived from vegetables and used in the manufacture of detergents, alkyd resins, plasticizers, etc. *Aceto Chemical Co., Inc., 40-40 Lawrence St., Flushing 54, N. Y.*

Polyethylene. File folder contains a series of "Polyethylene Processing Tips" which are designed to answer questions concerning operating conditions, types of polyethylene available, properties of polyethylene, services offered, etc. *U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp., 99 Park Ave., New York 16, N. Y.*

Urethane foam. History, chemistry, properties, applications, and fabrication of flexible synthetic urethane foams are detailed. 14 pages. *The Dayton Rubber Co., Dayton, Ohio.*

Machinery plant. The facilities of this company for the design and manufacture of a wide variety of heavy machinery and machine tools for the plastics and rubber industries are discussed in bulletin 59. 44 pages. *Farrel-Birmingham Co., Inc., Ansonia, Conn.*

Training booklets. Two booklets, one on compression and transfer molding and the other on injection molding, are designed to supplement the instructions of the foreman in a molding plant. Molding techniques, problems and their solutions, safety, handling, engineering drawings, etc., are presented. 50¢ each for less than 25-copy orders; quantity prices lower. *The Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y.*

Pentaerythritol. "The Little Steps," a 16-mm. sound-and-color motion picture, traces the development of pentaerythritol from a laboratory curiosity to a 100-million-lb.-a-year compound. Film runs 15 minutes. *Hercules Powder Co., Wilmington 99, Del.*

Plasticizers. Folder gives the key properties of a line of plasticizers for vinyl compounds. A chart presents performance data at 1550 p.s.i. modulus. 4 pages. *Rohm & Haas Co., Philadelphia, Pa.*

Engraving. Brochure describes facilities for engraving gravure printing cylinders of all sizes. Several types of printed products are illustrated. 12 pages. *Chambers-Storck Co., Inc., Norwich, Conn.*

Coating resins. Characteristics, specifications, properties, etc., are given for alkyd resins, styrene-alkyd copolymer resins, unmodified urea-formaldehyde resins, butylated melamine formaldehyde resins, and phthalic anhydride. 8 pages. *American Cyanamid Co., Plastics & Resins Div., 30 Rockefeller Plaza, New York 20, N. Y.*

Testers. Two brochures describe a Mooney shearing disk viscometer and a tester for tensile, compression, hysteresis, flow, etc. Advantages, characteristics, and specifications are given. 4 pages each. *Scott Testers, Inc., 101 Blackstone St., Providence, R. I.*

Stabilizers. Publication on vinyl stabilizer systems presents information on typical applications and performance ratings for calendered, extruded, and molded compounds, as well as for plastisols and organosols. 3 pages. *Ferro Corp., Bedford, Ohio.*

Processing equipment. Specifications, brief descriptions, and photos of a line of dry processing

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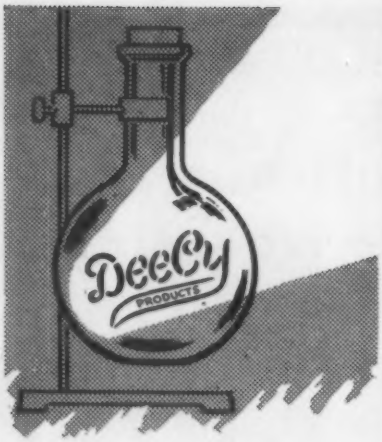


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equipment, including grinders, crushers, pulverizers, micron-grinders, separators, granulators, etc., are presented in brochure. 8 pages. *Sturtevant Mill Co., 150 Clayton St., Boston 22, Mass.*

Pipe, fittings, valves. Brochure describes how rigid vinyl pipe, fittings, and valves are installed; reviews applications; and describes physical properties. A chart lists common chemicals which can be handled by the vinyl materials. 8 pages. *B. F. Goodrich Chemical Co., Plastic Products, Marietta, Ohio.*

Rotary joints. Bulletin 14 describes a line of rotary joints used for conveying steam, vapor, or liquids under pressure between stationary and revolving units. Dimensions, engineering drawings, and specifications are included. 4 pages. *Sealol Corp., Warwick Industrial Park, Providence, R. I.*

Dielectric ovens. Bulletin 56-E describes a line of dielectric ovens suitable for heating, baking, drying, and curing a wide variety of non-metallic materials, including plastics. Advantages, specifications, etc., are given. 4 pages. *Young Bros. Co., 1831 Columbus Rd., Cleveland 13, Ohio.*

Polyethylene extrusion. "Fundamental Mechanisms in Polyethylene Extrusion" is a reprint which includes nine pages of charts and graphs. 20 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y.*

De-aerating heater. Technical Reprint T-149 presents information on sizes, dimensions, and space requirements of a de-aerating heater designed especially for small plants. Engineering drawings and specifications are included. 4 pages. *Graver Water Conditioning Co., Div. of Graver Tank & Mfg. Co., Inc., 216 W. 14 St., New York 11, N. Y.*

Equipment. Condensed catalog 564 presents technical data, brief descriptions, and photos of a line of vibratory materials handling

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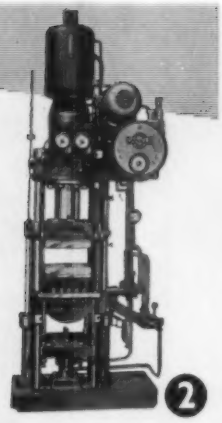
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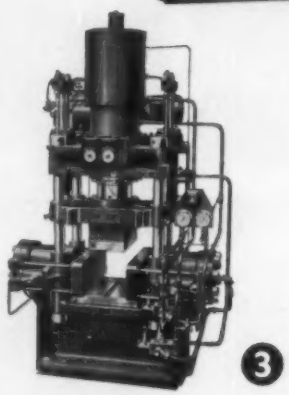


2

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3. SIDE RAM PRESS



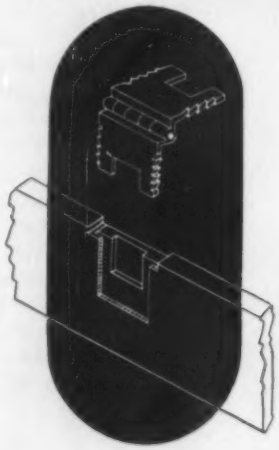
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Plastics Molding Division
AUBURN BUTTON WORKS, INC.
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equipment, selenium rectifiers, pile hammers, power tools, electric saws, etc. 50 pages. *Syntron Co., 390 Lexington Ave., Homer City, Pa.*

Thermostats. Catalog MC-124A presents physical, electrical, and performance data for a line of miniaturized and surface-mounted thermostats. Design and installation information is also given. 4 pages. *Fenwal Inc., Ashland, Mass.*

V-belt drives. Designed to help users of V-belt drives diagnose common causes of trouble, mailing pieces V-1400-M38P and V-1400-M40P discuss selection of proper drives, installation, belt adjustment, alignment, symptoms of failure, etc. *Worthington Corp., Harrison, N. J.*

Rods and tubes. Sizes and prices of a line of rod and tube stock —methyl methacrylate, Teflon, vinyl, polyethylene, cellulose acetate, and polystyrene—are presented; ordering data and specifications are included. 24 pages. *Friedrich & Dimmock, Inc., Lincoln Ave., Millville, N. J.*

Filters. Engineering data, dimensional charts, etc., are given in two brochures for all sizes of both sump-type and line-type filters for hydraulic oils, coolants, and lubricants (#107, 10 pages); and fire-resistant hydraulic fluids (#200, 4 pages). *Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.*

Solenoid valves. Flow charts, operation and construction details, illustrations, prices, etc., are given in Catalog 201 for a line of 2-, 3-, and 4-way solenoid valves. 34 pages. *Automatic Switch Co., Orange, N. J.*

Correction. An item in "Books and Booklets," August MODERN PLASTICS, incorrectly referred to Acrylite as an acrylic laminate. It is actually a single sheet of acrylic in which are embedded leaves, butterflies, fabrics, straw, etc. The booklet describing these sheets is available from *Wasco Products, Inc., Bay State Rd., Cambridge 38, Mass.*

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Export: Omni Products Corporation, 460 Fourth Ave., New York 16, N. Y.

GET SET and GO with Sterlco®



Model 6003 Dual

Model 6002 Dual

Model 6012 Single

Not shown: Model 6031 Triple Temperature Control Unit

TEMPERATURE CONTROL UNITS

mp Plastics

Production and sales figures in 1000 lb.* for May and June 1956

Materials	*Total p'd'n first 6 mos. of 1956‡*	*Total sales first 6 mos. of 1956‡*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	9,993	10,125
Sheets, 0.003 gage and over	8,316	7,810
All other sheets, rods, tubes	4,064	3,824
Molding, extrusion materials	44,310	43,599
Nitrocellulose sheets, rods, tubes	3,086	2,743
Other cellulose plastics	2,861	2,666
Phenolic and other tar-acid resins:		
Molding materials[a]	120,467	104,406
Bonding and adhesive resins for:		
Laminating (except plywood)	32,989	22,598
Coated and bonded abrasives	8,236	8,475
Friction materials (brake linings, clutch facings, etc.)	10,074	8,779
Thermal insulation	28,719	29,470
Plywood	22,019	17,904
All other bonding uses	16,349	16,123
Protective-coating resins	15,350	13,758
Resins for all other uses	15,894	13,881
Urea and melamine resins:		
Textile-treating resins	23,827	20,863
Paper-treating resins	12,835	11,990
Bonding and adhesive resins for:		
Plywood	53,814	49,202
All other bonding and adhesive uses, including laminating	13,476	11,733
Protective-coating resins	18,632	13,172
Resins for all other uses, including molding	45,772	41,197
Styrene resins:		
Molding materials[a]	223,204	207,449
Protective-coating resins	50,116	47,670
Resins for all other uses	50,785	50,254
Vinyl resins, total[b]	397,469	351,731
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		38,273
Sheeting (resin content)		28,798
Molding and extrusion (resin content)		97,292
Textile and paper treating and coating (resin content)[c]		30,020
Flooring (resin content)		29,976
Protective coatings (resin content)		13,517
All other uses (resin content)		37,190
All other vinyl resins for:		
Adhesives (resin content)		18,476
All other uses (resin content)		58,189
Coumarone-indene and petroleum polymer resin:	122,710	119,776
Polyester resins:	36,410	32,034
Polyethylene resins:	259,553	245,355
Miscellaneous:		
Molding materials[a, d]	22,019	18,881
Protective-coating resins[e]	5,025	2,570
Resins for all other uses[f]	60,392	54,886

*Dry basis designated unless otherwise specified.
†Revised. ‡Partially estimated.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

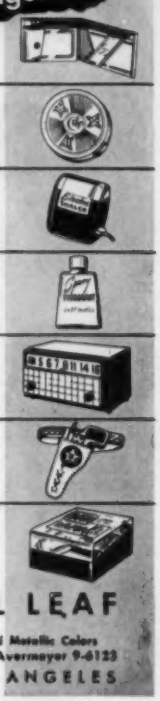
Production

From statistics compiled by the U. S. Tariff Commission

May†		*June*‡	
Production	*Sales*	*Production*	*Sales*
1,466	1,530	1,973	2,028
1,346	1,347	1,413	1,320
669	613	670	641
†7,458	†7,293	7,799	7,779
569	413	487	391
489	†504	407	389
†20,522	†17,681	18,991	17,830
5,403	3,312	5,093	3,547
†1,304	1,252	1,186	1,512
1,283	1,003	1,360	1,170
†4,461	†5,300	4,985	5,452
3,425	2,686	3,268	2,950
†2,759	†2,703	2,664	2,602
†2,576	†2,014	2,155	2,448
†2,588	†2,378	2,507	2,182
3,405	3,256	2,684	2,518
2,177	2,316	2,216	1,771
8,277	7,598	10,035	8,709
1,954	2,154	2,169	1,781
3,116	2,184	2,424	1,697
7,642	7,481	7,727	6,024
†41,187	†37,899	36,090	26,967
8,027	8,448	8,066	6,804
9,294	8,190	7,933	7,298
63,977	†58,204	54,833	52,737
	5,948		5,345
	4,403		4,217
	16,470		14,946
	4,322		4,727
	5,075		5,316
	†2,454		2,364
	6,087		5,228
	3,288		2,863
	10,158		7,731
20,966	20,238	19,465	19,031
7,289	6,887	6,404	5,725
†47,010	†41,802	45,634	44,137
†3,708	3,100	3,512	2,796
1,143	502	981	456
10,803	9,531	9,640	8,657

are given. *Includes data for spreader and calendering-type resins. ‡Includes data for acrylic, nylon, and other molding materials. *Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. †Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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GENERAL ROLL LEAF
General makes a complete line of roll leaf for hot stamping on every type of plastic. General Roll Leaf provides superior workability, finer definition and longer life. Available in the widest assortment of colors as well as genuine gold and imitation gold and silver.
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SURPLUS MODERN INJECTION MOLDING MACHINES,
TOOL ROOM & FACTORY EQUIPMENT plus
DIES & TOOLING FOR 5 PLASTIC PRODUCT LINES
BY ORDER OF FRANKLIN PLASTICS, Inc.
Franklin Penna.
Sale Date: THURS., OCT. 4, '56 at 10:30 A.M. Inspection: October 1 to Sale Date
Many Machines New As Late As 1948
INJECTION MOLDING MACHINES: (2) Model 9687, 16 & 22 oz. Watson Stillman (New 1948), (4) #10-D-8, 8 oz. & #10A2, 2 oz. Reed Prentice.
PLASTIC GRINDERS: (8) #137 DeMattias.
DRYING OVENS: (12) Clay 14 shelf 15"x28", 18"x24" 5 shelf.
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SAWS: 14" band, 24" Delta jig, 8" Dunlap circular.
GRINDERS & SANDERS: Delta toolmakers, (4) #86 Porter Cable & 3" bench type Sanders.
MISCELLANEOUS MACHINERY & EQUIPMENT: 7" Ammco Shaper, 4"x30" Logan Lathe, #2 Pratt & Whitney hand turret, #126A Burke hand mill, #HP7 Peerless Roll Leaf Machine, Henan Oil Purifier, (3) 16" Buffalo, 17" Delta, (2) 15" Walker Turner Drills, 5 HP Pennsylvania Compressor, Spencer Blower, Bostitch Stapler, (2) 36"x46"x49" DeVilbiss Spray Booths & Tank, Electric Lab Furnace, 1000# Floor Crane, Chain Hoists, Shop Trucks, 70' Roller Conveyor, Scales, AC Motors, Tanks, Tote Boxes, Cabinets, Electric Supplies.
PLUS Injection Molds for five plastics product lines: Wall Tile, Nesting Refrigerator Box Sets, Salad Bowls, Flower Pots, Phone Covers.
Machinery sold Piece by Piece—No Confirmation Necessary.
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In the manufacture of polyester Fiberglas sheets, Patapar gives "Satin Finish."

Effective releasing action in almost any situation is provided by the new Patapar Releasing Parchments. These special types of Patapar Vegetable Parchment have dense, fiber-free texture – high resistance to penetration or migration of oil and softeners – permanent releasing action. They are totally inert towards any surfaces they contact.

Patapar Releasing Parchments show highly satisfactory performance in many processes involving:



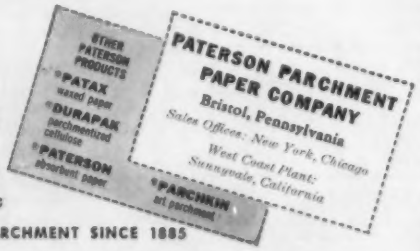
Patapar releases easily from pressure sensitive plastics.

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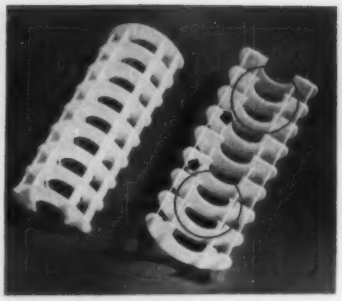
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Vegetable Parchment
HI-WET-STRENGTH • GREASE-RESISTING



HEADQUARTERS FOR VEGETABLE PARCHMENT SINCE 1885



Styrene louvers for fluorescent lighting system attach directly to tubes

Styrene louvers

New polystyrene louvers for fluorescent lighting systems are attached by clipping them right on to the tubular lamps, thus eliminating expensive fastening devices.

As shown in the photograph, each louver has two slotted segments near each end (see circled areas and arrows in photo), the projecting lips of which "give" slightly as the unit is pressed over the lamp. These lips hold the louvers firmly in place yet allow for easy removal.

The louvers, produced in 11-in. sections, are molded on an 8-oz. injection machine in a single-cavity mold. The mold is specially designed to permit easy ejection of the molded parts and to keep minimum pressure during the molding cycle. Each unit is rendered anti-static before packing by immersion in a bath of a destaticizing agent.

In addition to the resiliency of polystyrene which enables the louvers to be installed so easily, other advantages claimed for the new louvers include: 80% lighting efficiency, completely eliminating glare without loss of light at working positions; lightweight; and ease with which they can be removed and cleaned in warm soapy water. The louvers are produced in attractive, semi-translucent opal styrene.

Credits: Clipluve lighting louver manufactured by Tube Lamination & Engineering Ltd., High Wycombe, Buckinghamshire, England; Arquad destaticizing agent supplied by Armour & Co., Ltd., Smithfield, London, EC.1.



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Cellulose Products Division
EASTMAN KODAK COMPANY
Rochester 4, N. Y.



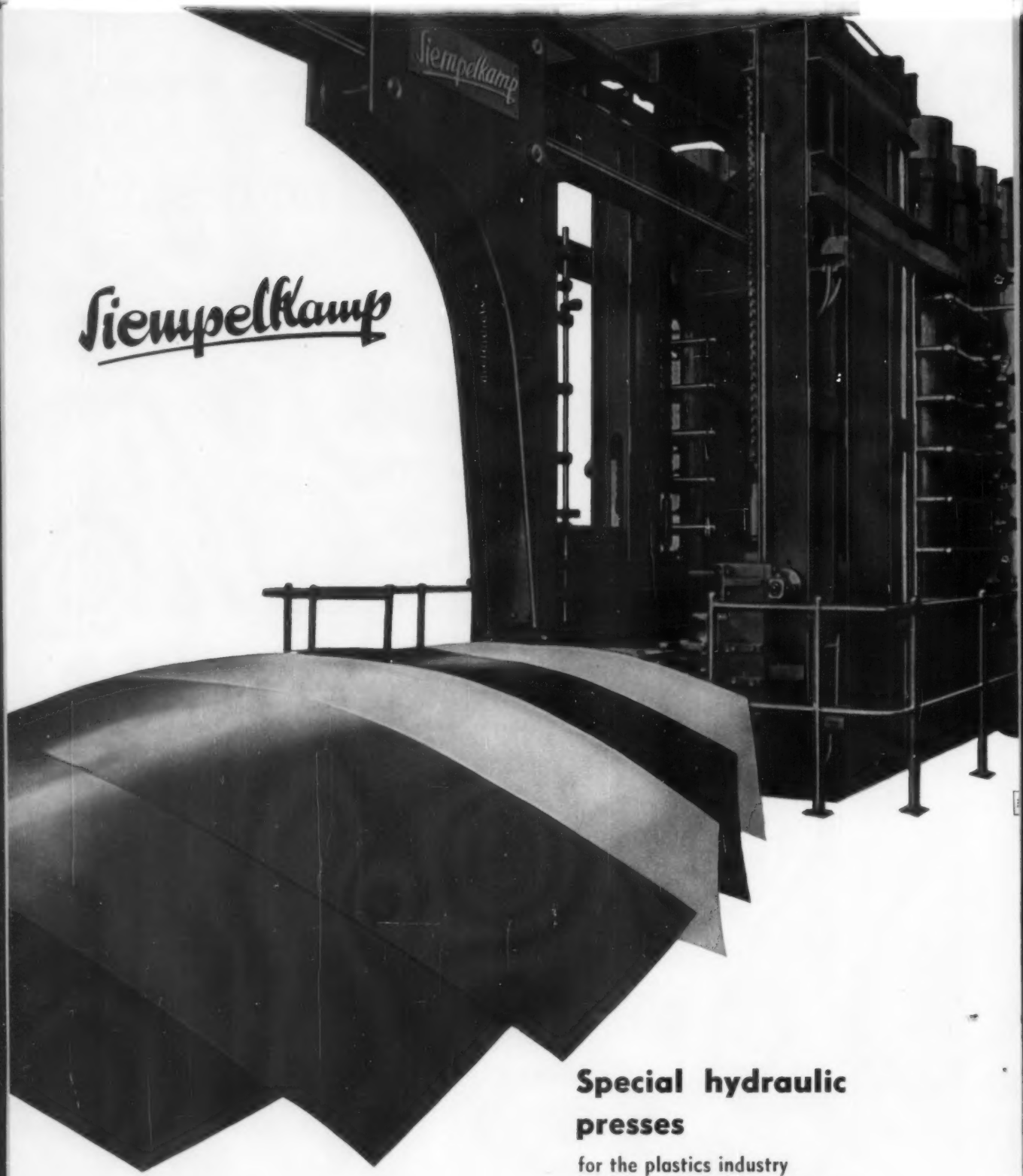
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Sales Offices: *New York, Chicago, Atlanta.* Sales Representatives: *Cleveland, Philadelphia, Providence.* Distributors: *San Francisco, Los Angeles, Portland, Seattle (Wilson & Geo. Meyer & Co.); Toronto, Montreal (Paper Sales, Ltd.).*

Fleetwing Double Decker Vanity by Shortrip Leather Products Co., Inc., New York

Color-animated



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for the plastics industry
for any pressure and temperature
with automatic loader and unloader

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Color-animated acrylic signs

Latest entry into the fast growing field of point-of-sale plastics signs is a line of acrylic signs in which a small motor-driven cam and a colored strip of Mylar film create the illusion of a perpetually moving rainbow-hued band of light around the border.

The signs, which can be produced in either rectangular or circular shape, are vacuum-pressure formed of ⅛ to 3/16 in. thick acrylic sheet. They are of the conventional fluorescent-lighted type; between the fluorescent bulbs and the back face of the sign, however, is a 0.003 in. thick strip of colored Mylar film, about 2 to 3 in. wide, which extends around the periphery. The motor-driven cam is attached to the Mylar in such fashion that it moves the strip ⅝ in. to left and right and up and down, causing red, yellow, and blue light to pass through ridges formed into the back of the acrylic sign. These ridges act as light-refracting surfaces, creating the effect of a band of rainbow-colored light moving in a circular pattern around the edge of the illuminated sign face.

According to the manufacturer, plans are underway to produce signs in which the colored border will be supplemented by copy or figures moving across the face.

Credits: Dynalite signs manufactured by Tel-A-Sign, Inc., Chicago, Ill.; Plexiglas acrylic supplied by Rohm & Haas Co., Philadelphia, Pa.; Mylar by Du Pont.



Acrylic sign uses small motor and strip of Mylar film to produce effect of moving color around border

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Results are accurate and reliable and can be reproduced precisely over and over again. The Weather-Ometer furnishes a yard stick to measure the improved quality of a plastic in development and to maintain a standard of quality in production.
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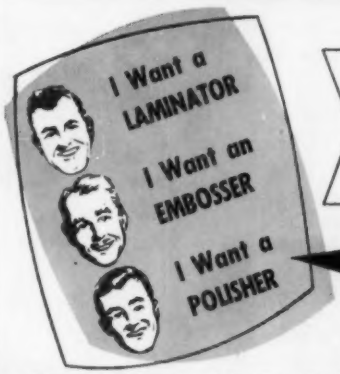


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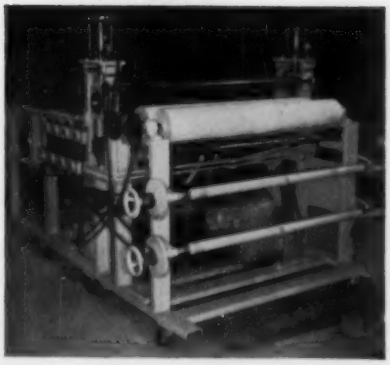
ATLAS ELECTRIC DEVICES CO., 4114 N. Ravenswood Ave., Chicago 13, Illinois





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Satisfies all



- Embossing roll changes made in 10 to 15 minutes. Speeds up to 36 yards per minute.
- No adjustments necessary after roll change. (NO MESSY GEARS TO CHANGE.)
- Electrically heated rolls deliver even temperature across entire width of web.
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- FOUR water cooled rolls chrome plated with two rubber pressure rolls. 8½" dia.
- Heat Splicer seals from 2 to 20 gauge with J BOX pinch rolls and VARI-DRIVE.
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- Price for standard 60" Model $9,990.00.
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Write for Illustrated Literature

T & M MACHINE AND TOOL CORP.
15 Greenpoint Avenue Brooklyn 22, N. Y.
EVergreen 3-1011

Polyethylene plug



SOLVIC COPOLYMERS

The following three materials are vinyl chloride — vinyl acetate suspension copolymers.

SOLVIC 513 P — Vinyl acetate content: ± 15%. PROPERTIES — Working temperatures: low; flow temperatures: very low (allows injection moulding without plasticizer). USES — LP records, vinyl-asbestos floor-tiles.

SOLVIC 523 K — Vinyl acetate content: ± 10%. PROPERTIES — Can be processed at low temperatures; easily produces clear sheeting or sheeting with transparent colours; permits extreme draws when made into sheeting for vacuum forming. USES — Rigid opaque, tinted or clear sheeting, deep vacuum forming.

SOLVIC 535 E — Vinyl acetate content: 5%. USES — General purpose copolymer.

SOLVIC POLYVINYLCHLORIDES

SOLVIC 100 series (122, 124, 136)
General- and special-purpose PVC resins, manufactured by the emulsion process; suitable for unplasticized extrusion and calendering, for blow-extrusion of unplasticized films, for injection moulding of unplasticized articles; Solvic 122 is prestabilized with non toxic products.

SOLVIC 200 series (235, 228, 235D)
General- and special-purpose PVC resins, manufactured by the suspension process; suitable for extrusion and calendering of plasticized articles; having excellent dielectric properties, Solvic 235 D is used for cable insulation.

SOLVIC 300 series (334, 336)
Paste-making PVC resins (plastisols and organosols); suitable for coating of fabrics and paper, dipping, hollow casting or slush molding, and soft cellular products.

Solvic is presently supplying PVC and copolymers in large quantities to plastic users throughout the world. In addition, Solvic manufactures PVC compounds and colour concentrates (master-batches) under the trade name, BENVIC.

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Write for additional technical information.

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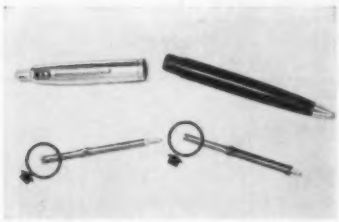
Affiliate companies in Austria, Brazil and Spain

Polyethylene plug for pen refill

Tiny injection molded polyethylene plugs, 0.067 in. ID and 0.125 in. OD, have made possible the first ball-point pen with a built-in spare refill. The new pen, named Capri Piggy Back, is supplied with two separate silvered-tip points and two ink supplies in a single unit inside the pen barrel. It is named Piggy Back because one refill "rides piggy back" atop the other. According to the manufacturer, it requires no more than ten seconds to put the refill into use.

The tiny polyethylene plugs, which are easily molded without the use of special techniques, are the key to the design of the new pen. The plugs, force fitted in the ends of the refills opposite the points, are of such size that the tip of one refill fits snugly into the plug in the other.

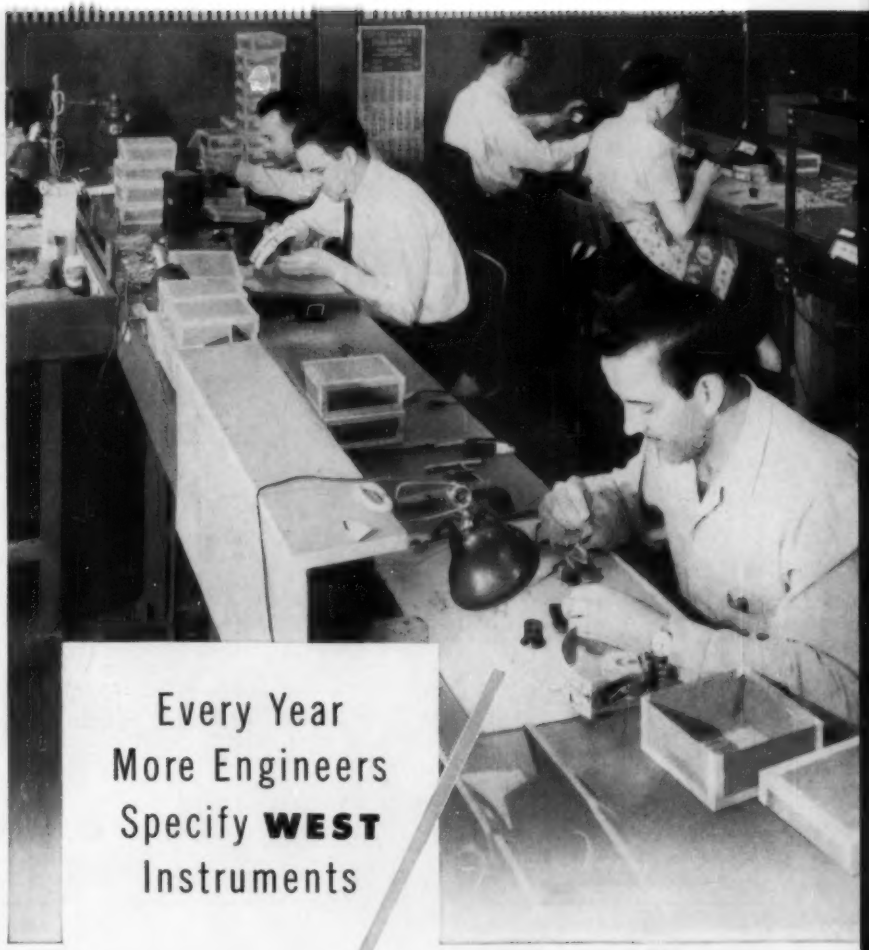
Polyethylene was chosen for this application because it is resilient enough to hold the piggy back refill snugly in position, and because it is chemically stable in the presence of polymerizing agents that might be present in the ink.



Polyethylene plugs make possible ball-point pen with its own spare refill

The attractive pen itself incorporates a barrel injection molded of cellulose acetate and is available in gray, red, black, and aqua.

Credits: Capri Piggy Back pen manufactured by Paper Mate Co., subsidiary of the Gillette Co., Chicago, Ill.; Alathon polyethylene supplied by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; Tenite acetate supplied by Eastman Chemical Products Inc., Kingsport, Tenn.



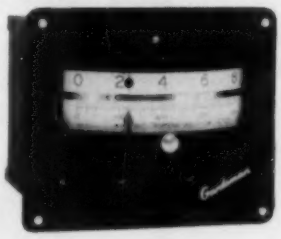
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Nylon rollers for film projector

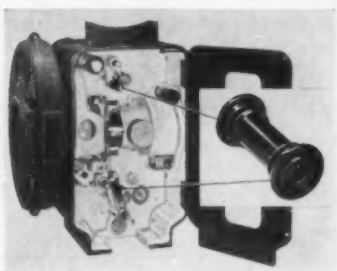
By replacing nickel-plated steel film-carrying rollers with graphite-impregnated nylon parts, the way has been cleared for the successful adoption of magnetic sound reproduction in motion picture theater projectors used in "wide screen" stereophonic-sound systems such as "Vistavision," "Cinerama," "Cinemascope," etc.

Previously, when film with magnetic sound recording "stripes" was used, erratic and unsatisfactory reproduction resulted when the steel rollers became magnetized. Nylon, being non-magnetic, eliminates such interference as well as the need for lubrication, due to its self-lubricating properties. In addition, the toughness of nylon is expected to give long service life to the rollers.

The nylon, which is first extruded into rod form, is subsequently machined on an automatic screw machine using special tooling equipment.

Accurate roller rotation and film guidance are assured through holding close tolerances. Such tolerances are also necessary to prevent the film from coming into contact with parts of the projector mechanism that might damage film and to assure precise meeting of the holes in the edge of the film with the sprocket teeth that transport the film through the projector.

Credits: Film carrier roll developed by Tri-Point Mfg. and Developing Co., Brooklyn, N.Y., and Century Projector Corp., New York, N.Y.; nylon supplied by Du Pont.



Graphite - impregnated nylon rollers for use in magnetic sound reproduction projectors

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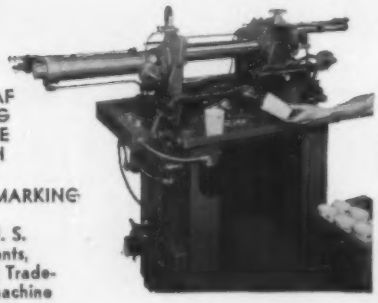
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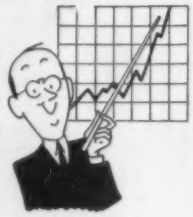
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In addition to the polyethylene stopper, a polyethylene lip which functions as the pouring edge of the bottle has also been developed. This not only assures a secure fit for the stopper, but provides a sanitary, non-drip pouring edge. It also prevents breakage of the top of the glass inner lining and eliminates the need for a hand-installed rubber gasket under the edge of the lining.

The cap-cup and two other cups which nest inside it in certain models of the vacuum bottles are molded of high-impact styrene. All plastics components are molded in gleaming red to provide distinctive identification as well as to reduce the tendency to pick up faint stains from foods or beverages.

Credits: Vacuum bottles and jars manufactured by American Thermos Products Co., Norwich, Conn.; polyethylene and styrene supplied by Catalin Corp. of America, New York, N.Y.; molding by Plastene Corp., Crawfordsville, Ind.

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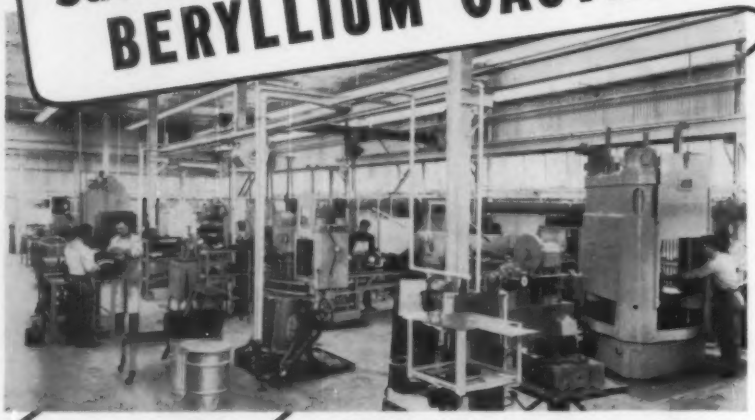
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Battery seals

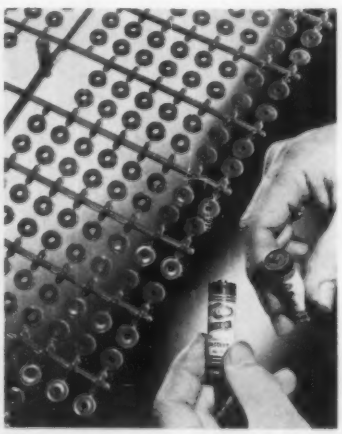
Another proof of the remarkable moldability of polyethylene is a new washer for dry cells which is being injection molded at a rate of 30,000 per hour.

The washer, which serves as a seal for the open end of dry cells, is injection molded in a 300-cavity mold; over 100 shots per hr. are achieved. Because of the flow properties of the polyethylene material used, this intricate molding job is run at normal molding temperatures. The small, circular pieces strip easily from the overall shot when it is removed from the mold.

In assembly, a washer is applied by force fit over a cell's brass-capped central carbon electrode to effect a tight seal around it. The perimeter is then sealed by crimping the metal edges of the cell over the outer edge of the polyethylene piece. Formerly, dry cells were finished by a cumbersome process of pouring molten pitch around the carbon anode to seal the open end.

In addition to reducing costs and simplifying assembly procedure, the polyethylene washers provide a watertight, electrically insulating seal that won't break or corrode.

Credits: Batteries manufactured by Ray-O-Vac Co., Madison, Wis.; washers molded by Evans-Zeier Plastic Co., Madison, Wis.; Tenite polyethylene supplied by Eastman Chemical Products Co., Kingsport, Tenn.



Polyethylene washers for sealing dry cells are produced in a 300-cavity mold

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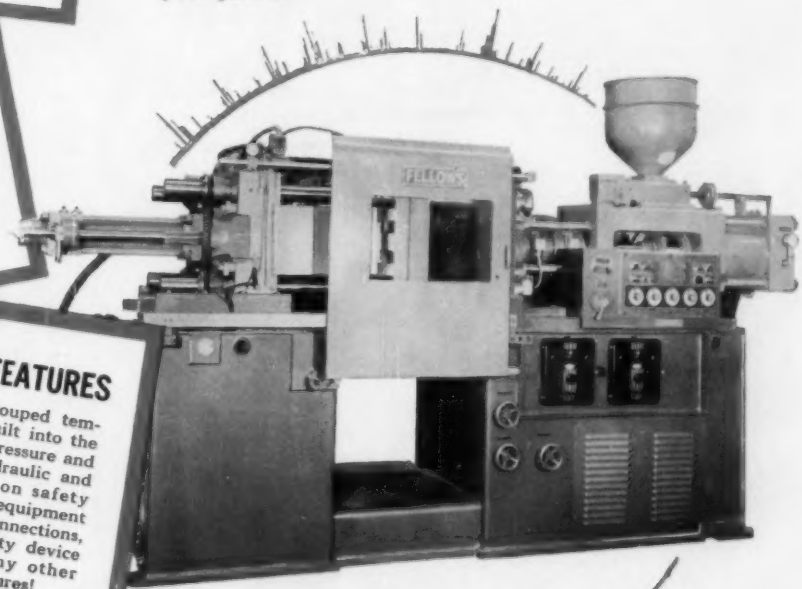
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the "6-200" has grouped temperature controls built into the machine, injection pressure and speed controls...hydraulic and electric interlocks on safety doors...and as extra equipment —counter air blast connections, alarm timer and safety device for mold...plus many other Fellows exclusive features!



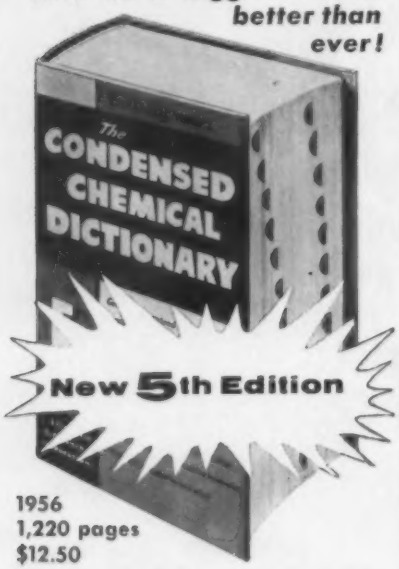
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injection molding equipment

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King-size moldings

(*From pp.* 123-128)

for such tasks as gardening, car washing, and household cleaning. Among its features are a sturdy wire bail with ribbed polyethylene hand grip and molded-in graduations which permit easy, accurate measurement of fertilizers, plant foods, and detergents. This polyethylene pail retails at $3.79; the lid sells separately for 69 cents.

Even the fabled "old oaken bucket" has its modern counterpart in a sturdy, molded polyethylene pail made by Flambeau Plastics Corp., Baraboo, Wis., shown in Fig. 9, p. 128. The 12-qt. pail, equipped with a tight lid and wide handle, is an excellent food or drink container for picnics and sports outings and is also handy around the home or farm for cleaning, gardening, or holding food, sewing, etc. A graduated quart scale, molded on the inside wall of the pail, saves time and effort in measuring out stock feed, lawn chemicals, etc. Made in a light oaken color, this pail has simulated wooden staves, hoops, and rivets which give it an authentic oaken bucket appearance.

Plastics and metal have been effectively combined in a new 6¼-qt. capacity molded polyethylene ice bucket produced by Plas-Tex Corp. This unit, shown in Fig. 10, p. 128, featuring double wall construction and fibrous glass insulation, will not sweat or mar surfaces against which it rests and will keep ice cubes as long as 18 hours. The trim and handle, of non-tarnishing brass, are important factors in upgrading this bucket into a product which even the most discriminating hostess would be proud to place before her guests. The handle is so mounted that it locks into position horizontally to hold a towel when the bucket is filled with ice and used for chilling wine.

Merchandising phenomena

There are two phenomena in the merchandising of these big and high-priced polyethylene products. The first is that—because of design—their prices are generally not much higher than quality metal products serving the same purposes. The second is that—through the proper use of good colorants in the materials and through the use of bold informative labeling—these products, unlike the competing metal products, are ideally suited for "impulse" purchase and self-service sales.

With 53 million family units in the U. S. today, each of which requires one or more of these big units which may weigh from 3 to 12 lb. and with industrial, commercial, school, and civic markets hardly tapped, business in these lines should be good for a long time to come. Four million babies are born every year and if only one baby in ten gets to be bathed in a polyethylene baby tub weighing 40 oz., a million lb. of polyethylene would be sold to this single segment of the market. The Market Research Department of Spencer Chemical Co. has conservatively estimated that between 35 and 45 million lb. of polyethylene could be the realistic potential in applications involving wastebaskets, utility pails, and dishpans alone.

How to extend the market?

Can this business be lush forever, particularly when these products are so durable? If each of the 53 million homes has a tremendously durable polyethylene trashcan, how many householders can be sold an extra one? If each kitchen has a polyethylene garbage pail and a polyethylene laundry basket, if each bedroom has a polyethylene wastebasket, what can be done to sustain the market? Since structural damage is almost impossible, it is the belief of material makers and molders alike that the extension of the market will depend on the adroit use of color and design. Women just love to change styles and color schemes. Today's bedroom wastebasket may end up in the garage or workshop tomorrow; today's dishpan may end up as a garden tool. At Monsanto's request, Richard Neagle Assoc., Philadelphia, Pa., has explored this design field from the standpoint of efficiency in molding and in function, and has come

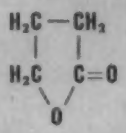
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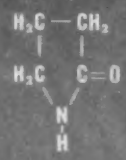
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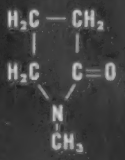
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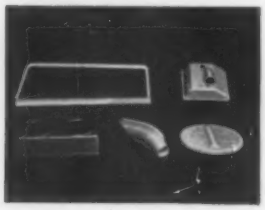
3. Because the greater uniformity of physical characteristics thus obtained permit the use of Fabricon reinforced plastic moldings on countless applications generally considered impractical or, indeed, impossible just a few short years ago. And . . .

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up with a number of ideas, a selection of which are shown on p. 127.

The next step toward market extension will be the development of more items to take over from metal, wood, or other materials. Clothes hampers, infant's furniture, big toys, and food containers are just some of the ideas currently being studied. And there appear to be great possibilities for plastic materials in insulated products which can be double walled with foam cores.

Not too many molders are presently in a position to go into this big polyethylene piece business. On injection machines, which cost anywhere from $50,000 to $160,000, are placed molds which cost from $10,000 to $35,000 to make products which sell at retail for between $3 and $13. Involved are all the costly elements of distribution, including packaging, labeling, displays, advertising, and transportation. Only a well-financed molder who has a fair amount of experience in proprietary marketing can hope for success in this field.

"Who needs to boil a trash can"

A moot question is the extent to which the high density or high modulus polyolefins will affect this market. One molder points out that very high density polyethylenes are hard and generally shiny, that they would be almost as noisy as metal and would have little advantage in these applications, and asks: "who needs to boil a trashcan?" Certainly for items which must have resistance to high heat and boiling water the high density polyethylenes will find a good future in housewares. But if, out of the polyolefin group, which includes the polyethylenes, the polypropylenes, the isobutylenes, and others, can come a low density high modulus material, the picture can change quite radically because of the economics of weight. With such a development, it should be possible to cut down wall sections while retaining strength and most other desirable properties of the materials.

The rigidity and slickness of the high density materials in mold-

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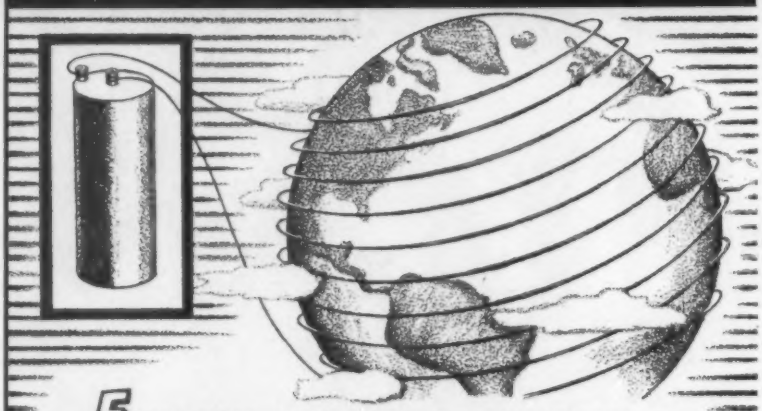


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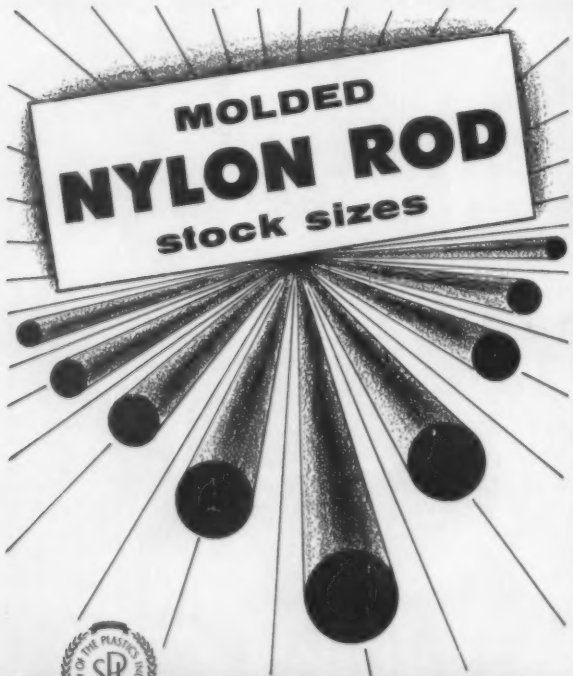
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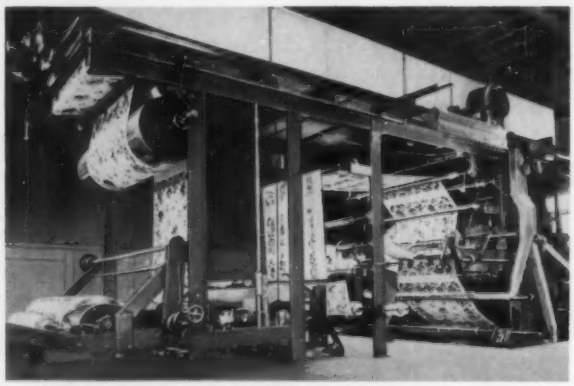
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ings might lead them into drawers and other furniture components, particularly for hospitals where sterilization is necessary. Says Dr. R. F. Boyer, director of plastics research of Dow Chemical Co.: "These linear polyethylenes should take some markets now held by the more rigid thermoplastics such as vinyls, polystyrenes, and cellulosics."

Except for television tube shields, almost nothing has yet been done in custom molding big product polyethylene components. It is almost certain that the success in utility of these big proprietary products will bring about such developments.

Thermoforming potentials

In this field of big polyethylene pieces, little or nothing has yet been heard from the thermoforming processors. Few would be surprised to hear of the introduction of some large products made by vacuum forming polyethylene sheet. However, the problems of design for the depths of draw involved, the problems of finish, and the problems of styling have still to be satisfactorily overcome.

Blow molding

Finally, no one yet knows what may be done by mass-production blow molding of polyethylene into such large pieces. Plax Corp. is producing a 13-gal. polyethylene drum by blow molding; a number of companies are blow molding big bottles. This technique may be an earlier competitor in this field to injection molding than will the thermoforming process.

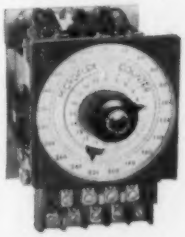
50% to king-size moldings

In 1955, through 161,000 retail outlets, American families purchased plastic housewares at an average rate of $4 per household per year. Sales of the king-size polyethylene housewares are increasing at a faster rate than that of all other housewares, plastics or not, combined. If polyethylene will be going into housewares at a rate of 100,000,000 lb. per annum at the end of 1956, it seems quite possible that in 1957 fully 50,000,000 lb. will go into the king-size moldings.—END

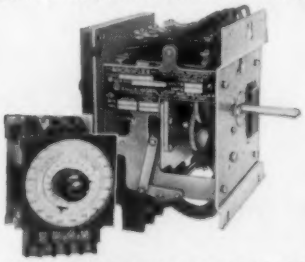
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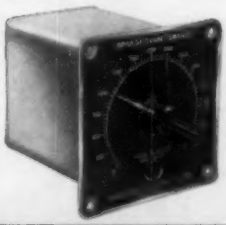
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Up-grading luggage

(*From page* 133)

One of the problems confronting a luggage manufacturer is the prevention of excessive mirror breakage in train cases. By switching to a polyethylene frame, Reliable Luggage states that it was able to cut such breakage in cosmetic cases by 300 percent! In addition to this functional advantage, these frames also add a decorative touch.

Molding of the mirror frame is done in a multi-cavity mold on 12-oz. injection machines. A molded-in groove along the inner edge of the frame holds the mirror securely. A flange around the outside of the frame is used to attach the mirror assembly to the inside lid of the case. A leather-grain texture is also molded into the frame.

Covered tray for train case

In its Travel Joy train case, Reliable Luggage has now incorporated a high-impact polystyrene tray and cover. Molded in one piece with integral color, the tray replaces a hand-covered wooden container. By switching to a molded tray, the cost involved in covering the wooden trays has been completely eliminated. In addition, since the partitions that divide the tray into compartments are molded in, there is no danger of joints coming loose. A flange molded around the top edge of the tray holds it in place and permits it to be easily removed when desired.

Reliable has also found that the new impact styrene trays have greater strength than the old wooden models; what is perhaps even more important, the styrene tray is reported to have greater feminine appeal.

Both trays and lids are molded in a family mold on 12-oz. injection machines. No finishing operations are required.

Credits: Handles, mirror frames, trays, and lids molded by Bruce Molded Plastic Products, Inc., Pittsburgh, Pa., using 12-oz. Lester-Phoenix and Federal injection machines. Tenite polyethylene by Eastman Chemical Products, Inc.; Dylene polystyrene and Dylan polyethylene by Koppers Co., Inc.

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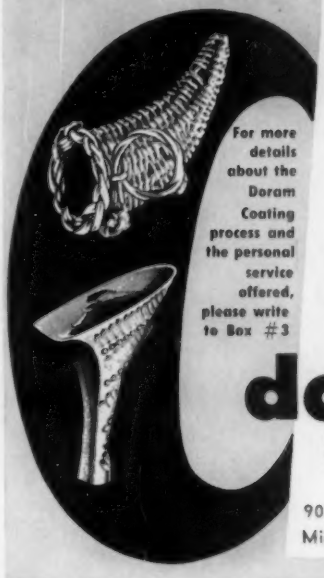
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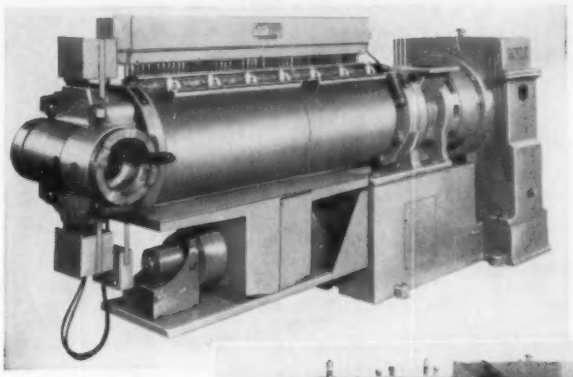
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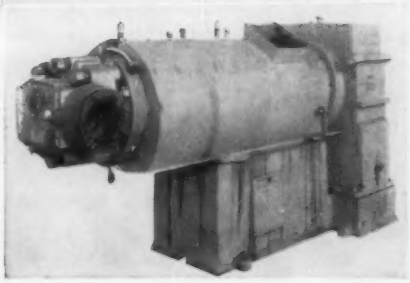
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SELECTOR CHART FOR STABILIZERS AND PLASTICIZERS. 12-page booklet describes, in chart form, recommended applications, advantages, and properties of company's vinyl stabilizers and plasticizers. Includes description of gelling agents and special chemicals. National Lead Company. **(J-602)**

HOW TO FABRICATE AND FORM VINYL SHEET. 10-page service bulletin describes the fabrication and molding techniques for unplasticized, rigid polyvinyl chloride. Includes data on applications, corrosion resistance, and physical properties. Seiberling Rubber Company. **(J-603)**

CATALOG OF STOCK MOLDED PARTS. Catalog describes line of stock molds suitable for instruments, housewares, appliances. Includes actual size illustrations, specifications. Harry Davies Molding Company. **(J-604)**

POLYETHYLENE INFORMATION BOOKLET. 12-page booklet contains general discussion in non-technical terms of the uses, physical composition, development, processing, and fabrication of polyethylene, including the applications and properties of company's polyethylene resins. U. S. Industrial Chemicals Company. **(J-605)**

FURFURYL ALCOHOL BOOKLET. 26-page booklet describes the use of furfuryl alcohol as a resin component and as a solvent. Includes charts of physical and chemical properties. The Quaker Oats Company. **(J-606)**

SPRAY PAINTING. Loose-leaf catalog describes company's automatic spray painting equipment for molded plastic parts, masks for protecting surfaces while painting, and paint wiping equipment. Finish Engineering Company. **(J-607)**

POLYESTER RESINS. 24-page handbook describes line of unsaturated polyester resins, transformable into thermoset, transparent plastics. Includes applications, general properties, fabrication techniques. Pittsburgh Plate Glass Company. **(J-608)**

AUTOMATIC MEASURING AND CUTTING MACHINE. 6-page folder describes machine which feeds, cuts, counts such continuous lengths as stripping, belting, and hosing. Cuts up to 45 pieces a minute from 1" to 12'. Fidelity Machine Company. **(J-609)**

PRIMER ON GLASS-REINFORCED PLASTICS. 26-page booklet describes applications of fibrous glass-reinforced plastics. Gives properties for reinforced alkyd, polyester, phenolic, melamine, and polyester. Contains a description of molding processes required. Owens-Corning. **(J-610)**

EXTRUSION DIES AND EQUIPMENT. File folder contains data sheets which describe line of extruders, dies, and other equipment. Includes description of company's sheeting haul-off equipment. Includes specifications. Robbins Plastic Machinery Corporation. **(J-611)**

PROTECTIVE ADHESIVE MASK. Folder describes pressure sensitive sheeting for protecting surfaces of plastics during fabrication, assembly, and storage. Standard rolls available 36 in. wide by 100 yds. long. Mystik Adhesive Products. **(J-612)**

PRODUCT IDENTIFICATION. 16-page brochure describes wide range of uses of decals for product marking. Includes selector-chart of company's line of decals with information pertaining to physical features, designs available, and acceptable surfaces. The Meyercord Company. **(J-613)**

VINYL CALENDERING COMPOUND. 14-page manual describes "Vygen 2201," an uncolored modified rigid polyvinyl chloride compound for calendering operations. Gives detailed calendering and Banburying instruction. Includes charts of physical properties, chemical resistance. General Tire and Rubber Company. **(J-614)**

RUBBER-PHENOLICS CASE HISTORIES. 32-page brochure describes company's rubber-phenolic molding compounds with illustrated case histories of many applications. Available as woodflour-filled, asbestos-filled, flock-filled, fabric-filled. Includes comparison charts of compound and conventional phenolics. General Electric Company. **(J-615)**

"BAKELITE" BROCHURE. 12-page brochure summarizes data about the wide range of uses for Bakelite phenolic, vinyl, styrene, polyethylene, fluorothene, polyester, silicone and epoxy plastics and resins with laminating plastics, flexible film and sheeting, molding materials, extrusion materials, and others. Includes specific properties. Union Carbide and Carbon Company. **(J-616)**

PLASTIC STRIP DICER. Data sheet describes three models of a notched-knife cutting machine for pelletizing rigid or semi-soft polystyrene, polyethylene and vinyl strip in sizes from 6" to 14" width. Mitts and Merrill. **(J-617)**

HYDRAULIC PUMPS AND CONTROLS. 56-page catalog details applications, specifications, and performance data for extensive line of hydraulic pumps, motors, and controls. Vickers, Inc. **(J-618)**

VINYL STABILIZERS. Folder describes applications for vinyl stabilizers in a wide variety of compounding operations. Recommended formulations for such end uses as plastisols are included. Harshaw Chemical Company. **(J-619)**

ELECTRIC CARTRIDGE HEATERS. Folder describes cartridge heaters for applying spot heat to dyes, platens, molds. Includes illustrations and specifications of several heaters in a variety of diameters, lengths, wattages and voltages. Edwin L. Wiegand Company. **(J-620)**

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HEAVY DUTY THERMOSETTING PLASTIC. Folder describes "Micarta," company's heavy duty plastic available as a molding material and in a variety of laminated and molded shapes. Includes machining suggestions, two-page selector chart with grades, applications, specifications, physical and chemical properties. Westinghouse. (J-623)

HARDNESS TESTER. Data sheet describes 12 oz. portable hardness tester with spring loaded indenter. Reading dial is divided into 100 graduations. Includes prices. Barber-Colman. (J-624)

CUTTING TOOL CATALOG. 36-page catalog describes extensive line of cutting equipment such as files, reamers, and drills, suitable for finishing, de-flashing and shaping plastics. Includes illustrations, detailed specifications, prices. Severance Tool Industries, Inc. (J-625)

FLUOROCARBON PRODUCTS. 8-page brochure describes uses, available forms, and properties of "Kel-F" fluorocarbon molding and extrusion plastics, dispersions and coating resins, and inks for plastic surfaces. M. W. Kellogg Company. (J-626)

WEB SLITTER AND REWINDER. Illustrated folder describes equipment for slitting and rewinding web fed sheeting in speeds as high as 1000 ft. per minute, in rolls of 250, 500, 1000, or 2000 lbs. Includes specifications. Hobbs Manufacturing Company. (J-627)

WEB FILM EXPANDER. 6-page folder describes ball bearing mounted expander for producing maximum width and for removing wrinkles during winding and unwinding operations. Includes diagrams with specifications. Mount Hope Machinery Company. (J-628)

VACUUM FORMING EQUIPMENT. Folder describes line of vacuum forming equipment and a die press for cutting formed plastic sheets. Fully automatic cycling. Includes specifications, prices. Abbott Plastic Machine Corporation. (J-629)

MOLDED NYLON GEARS. Bulletin describes advantages, gives general design details, and discusses stresses, for gears made of "Akulon," a nylon molding powder, suitable for injection molding, extrusion, and available in rods for machining purposes. Algemene Kunstzude. (J-630)

"TEFLON" STOCK. 12-page brochure describes company's fabrication and distribution of "Teflon" sheets, tape, molded and extruded shapes. Includes detailed charts of sizes, weights, lengths available and tolerances. U. S. Gasket Company. (J-631)

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CORROSION RESISTANT PIPE. Catalog illustrated with schematic drawings gives detailed specifications for line of "Agile" corrosion-proof thermoplastic pipe, fittings, valves, tubing and ducting, and gives the properties of the five plastic materials from which the piping is produced. American Agile Corporation. (J-635)

HANDBOOK OF SPECIAL-PURPOSE ADDITIVES. 36-page illustrated handbook describes five grades of "Chlorowax" chlorinated paraffin additives for plastics compounds, formulated to improve chemical resistance, flame retardance, and water repellance. Diamond Alkali Co. (J-636)

SPRAY PAINTING EQUIPMENT. Bulletin describes a large automatic spray painting machine, designed to spray areas up to 12 inches wide and 40 inches long. Conforming Matrix Corp. (J-637)

POLYETHYLENE EXTRUSION LAMINATOR. 8-page illustrated brochure describes a line of three "Dilts" extrusion laminators, designed to combine polyethylene film with paper, tissue, board, foil, fabric and cellophane. The Black-Clawson Co. (J-638)

BALSA WOOD AS CORE MATERIAL. Folder describes properties, characteristics and special values of balsa wood as a core and sandwich material. International Balsa Corporation. (J-639)

INJECTION MOLDING MACHINES. Illustrated booklet gives detailed information on prices, specifications, and performance of "minijector"-line of ¾ oz. injection molding machines, suitable for laboratory and limited-production molding. Newbury Industries. (J-640)

MOLD DIE STEEL PLATES. Two bulletins describe steel for mold bases and die sets. Includes properties, analysis, heat treating data and applications of "Speed Case," low carbon, and "Speed Treat," medium carbon, free machining open hearth steel plates. Suggested uses include mold bases and die sets. Jones & Laughlin. (J-641)

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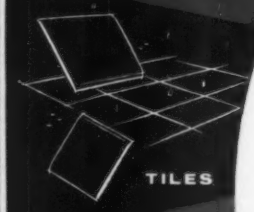
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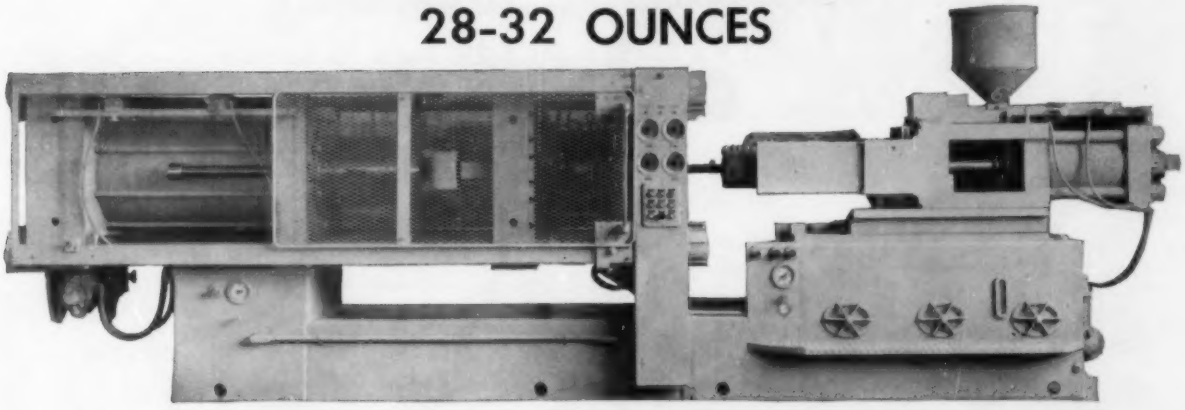
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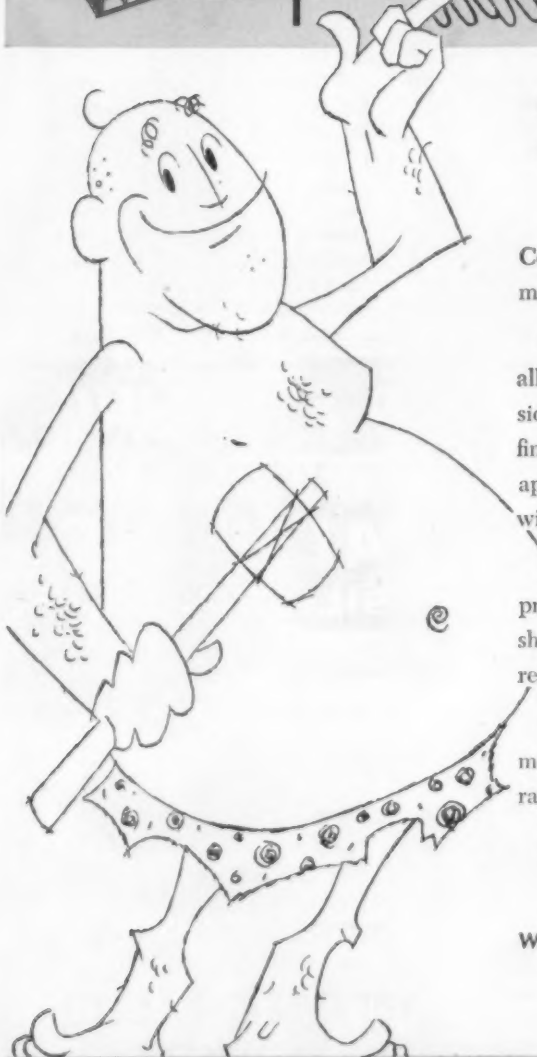
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Injection Pressure	21,200 p.s.i.
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Records

(*From pp.* 152-154)

spliced at that point using cellophane tape on the back of the web. In splicing, one set of guide marks is superimposed exactly over those of the adjacent recording, so that the distance between records will not be affected. A small differential here could cause serious difficulties later on when the records are cut apart and separated.

The edited records can then be shipped in roll form to the customer. Rainbo is also equipped to cut the web into individual records as it emerges from the editing machine and to paste or otherwise affix the record to a backing material or ship the individual records to the customer to do his own mounting.

Application possibilities

The completed records measure just under 7 in. in diameter and can be played on conventional phonographs at 78 rpm. The record can be supplied with the center hole already punched out or, as in the case of the Wheaties records, the hole can be punched out by the end-user with a pencil or similar instrument.

The largest run on the records thus far has been for the Wheaties cereal boxes. These were delivered to General Mills in rolls for affixing directly to the boxes. Eight titles, including such standby favorites as "Take Me Out to the Ball Game," "Dixie," and "Yankee Doodle Dandy," were pressed in the first series. Each record plays approximately 50 seconds.

Musical maps

A number of recordings have also been used by Mattel, Inc., Los Angeles, Calif., for a "musical map" featured at Disneyland. The map is a large cardboard sheet, accordion-folded into six panels each measuring 7½ in. across and 14 in. high. The bottom half of the map, when folded flat, is a guide to Disneyland, complete with legend. To the top halves of five of the panels are attached records pressed on cellulose triacetate film and glued to the cardboard. Each record describes part of Disneyland.

Several magazine inserts have also been made using the plastic records. One magazine bound an original recording into an issue, another used a record insert as part of an advertisement plugging a new musical film, and a third used a record on which a singer's face had been printed to dramatize an article on the singer.

The Squirt Co., bottlers of soft drinks, used recordings of Christmas carols as give-aways on their bottles. The record was affixed to a card, into which was punched a hole that fit snugly and securely around the neck of the bottle.

Other applications are now being researched. As a premium or as an advertising gimmick, the potential of the plastic records is almost limitless . . . thanks to thin, tough, inexpensive cellulose triacetate film that can provide such high fidelity and long playback life.—END

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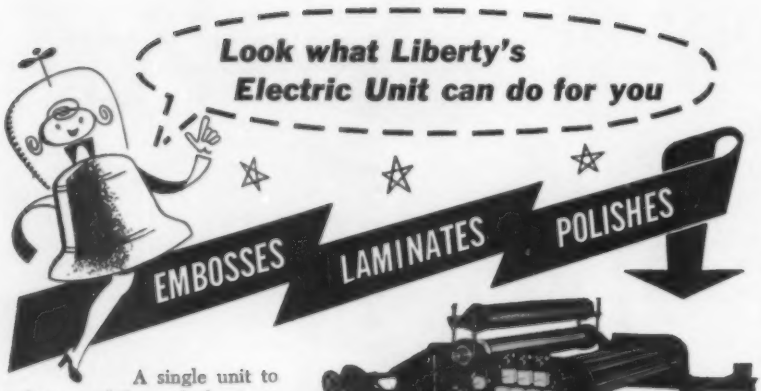
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1 to 4 cases (12 cans each)	$16.80 per case
5 to 9 "	15.60 " "
10 to 24 "	14.40 " "
25 or more cases	13.20 " "



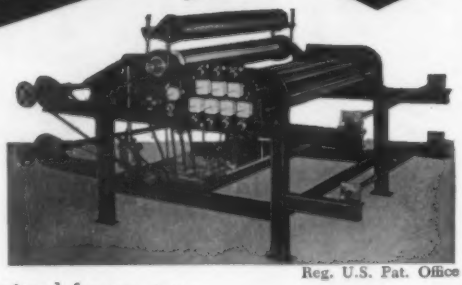
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Reinforced Molding

(*From pp.* 155-159)

its smooth, seamless interior, materials will not cake or become wedged in the cracks and crevices normally found in a metal bucket. And, finally, the plastic is less than ⅓ the weight of a similar metal bucket. This means that less expensive elevator belting can be used and less horsepower is needed.

Application possibilities

The development of the Dura-Buket is typical of the many new applications for the reinforced thermosets that have now started to break loose after many years of slow field and laboratory evaluation tests. And as the Dura-Buket has already opened up the field of materials handlings (in industries other than the feed industry) for an increased use of reinforced molding compounds, these other new applications are similarly encouraging the reinforced thermoset materials to branch out into even newer fields.

As might be expected, the majority of applications are industrial ones, with prime emphasis on electrical applications. In the consumer field, activities are relatively limited, but there is a possibility that an exciting new development only recently announced — molded sisal-phenolic (from Fiberite) parts for two of Admiral Corp.'s portable phonographs—may soon be responsible for shaking loose a whole new raft of consumer applications for reinforced thermosets.

Industrial uses

In the industrial field, the largest users of reinforced phenolics are the automotive, power transmission, and electrical industries. Many of the applications in each of these fields are old, familiar ones for reinforced phenolics, e.g., timing gears, terminal boards, electrical switchgear, etc., but just as many new ones are now starting to show up. Fiberite, for example, reports that currently under investigation are several cotton fabric-reinforced phenolic sprockets for use with timing belts. These high-impact phenolic

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sprockets offer many advantages including lower cost because of molded teeth, longer wear, higher operating speeds, and less noise. It has been found that the phenolic sprockets will operate satisfactorily at twice the pitchline velocity that is recommended for metal.

With the success of this application, a much larger use of cotton-reinforced phenolic is anticipated in the gear and sprocket fields in the not too distant future.

Reinforced phenolics also continue to show progress in such established market areas as aircraft pulleys, instrument housings and casings, conduit caps, industrial truck casters, portable tool housings, etc.

Durez Plastics reports on a new one-piece cup case for a thermometer being molded of their glass-phenolic material for Weksler Thermometer Corp. The reinforced phenolic was chosen for the application because of its high impact qualities, excellent dimensional stability, and heat resistance. In addition, the molded reinforced phenolic case is resistant to the chemical action of petroleum products and aromatic hydrocarbons. Its low thermal conductivity insures maintenance of sample temperatures. It is also an excellent insulator and, in addition, is non-sparking.

From Rogers Corp. come reports of a 35% reduction in the cost of an electric meter bracket achieved by switching to a medium-high-impact phenolic. The high strength of the material plus the fact that it can be drilled and tapped eliminated the need for metal mounting lugs. In the new phenolic brackets, these lugs are molded in, saving many assembly operations.

Further evidence of the adaptability of the reinforced phenolics to the most rugged conditions is offered by a molded glass-phenolic (from Durez) radiosonde case being used by the U. S. Government for carrying weather recorder-radio transmitters into the stratosphere. The purpose of the case is to protect the sensitive instruments from damage after the entire unit has been sent up on a balloon and dropped 17 miles

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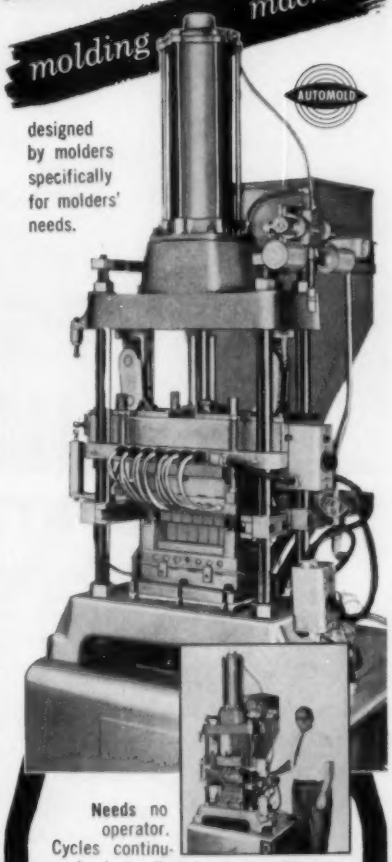
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Electrical applications

Glass-silicone compounds are currently finding their largest outlet in Class H electrical insulating components, including coil forms, slot stick wedges, terminal boards, connector plugs, switches, and insulators. The material also holds considerable potential for molded parts for radio, television, radar, and other electronic equipment and should prove valuable in aircraft and missile applications.

Dow-Corning, for example, reports on a molded glass-silicone terminal block designed for aircraft and guided missile service (by American Electronics Mfg., Inc., Culver City, Calif.). The unit, which incorporates brass inserts and an induction potentiometer, is lightweight, of high mechanical strength, has good dielectric properties, and excellent heat resistance, and is built to operate in ambient temperatures as high as 750° F. To qualify for the job, the molded parts withstood five room-temperature shock tests at 50 G's plus constant vibration in the order of 25 G's for 4 hr. at 600° F. Finally, the unit was subjected to 1050° F. for 15 min. While the molded silicone-glass terminal blocks shrunk and were charred by the heat, the molded-in brass inserts remained firmly in place in the terminal block.

The future

As the applications described above indicate, the future for the reinforced phenolics, melamines and silicones looks bright. Within the next five years, their growth is expected to accelerate at a pace far greater than ever before in their history—and the textile industry, by coming out with new and more effective fibrous materials, is being counted upon to contribute heavily to this growth.

Credits: Special thanks for assistance in the preparation of this survey is given to Paul E. Fina, Director of Sales Engineering, and John E. David, General Manager, Fiberite Corp.

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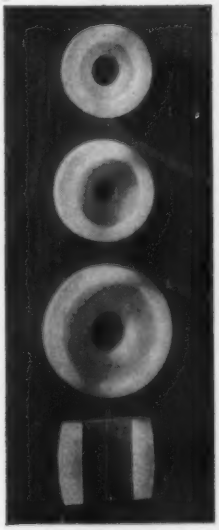
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(*From pp.* 138-143)

remaining 200 tons for sheets, varnishes and topcoats, drive belts and coverings, bottles, filaments, tapes, etc.

Important to the development of the materials was the increased use of injection molding compounds; in addition, high melt viscosity compounds were developed which open up new possibilities for the production of articles by the extrusion and blowing processes.

Cross-linked polyurethanes

In the form of foams (Moltoprene), the polyurethanes represent one of the most interesting and most promising of all German plastics developments.

In the technical field, the rigid foams have found use as load-bearing and supporting cores for sandwich constructions, as well as heat insulation in buildings and vehicles. In the form of elastic foams, they are used not only for a large number of consumer items but also for cushions, as interlining for clothes and, woven together with yarns, as textile material.

On the same chemical basis there has been developed a plastic of rubber-like elasticity (Vulkollan) which has exceptional abrasion and impact strength, as well as good resistance to gasoline and oil.

Separate production statistics for this group of plastics have not been published.

Silicones

The diversified possibilities for silicones in the form of oils and resins have been still further increased by the creation of new types. In silicone rubber, for example, a cold-cured compound which is supplied in kneadable, brushable, and pourable form, represents a particularly important step forward.

Raw materials

The raw-material prerequisites for further increases in German plastics production are present in principle. To a large extent, coal and coke are still the bases for chemical syntheses which lead to important intermediates.

However, the petrochemical raw materials, natural gas and crude oil, are gaining in importance for obtaining low-priced hydrocarbons, particularly olefins, which are important for certain plastics. In 1955, 130,000 tons of petroleum products (including refinery gas) and 105 million cubic meters of natural gas were processed, largely for petrochemical products.

In Germany, the Chemische Werke Hüls has the largest capacity for petrochemicals. In addition to natural gas, large quantities of refinery gases from the hydrogenation plants located in the Ruhr are being processed.

The Phenol-Chemie G.m.b.H. of Gladbeck at the present time produces 11,000 tons of phenol and 7000 tons of acetone from propylene by the Cumene process. The capacity will be expanded by the end of this year to 16,000 tons and 10,000 tons re-

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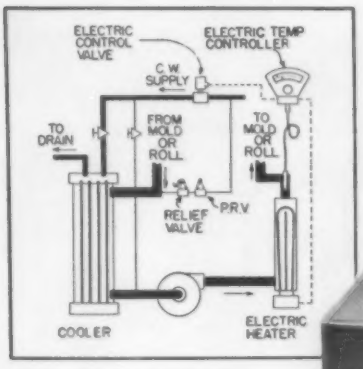
For further information and a list of the new prices for KEL-F molding powders, write: The M. W. Kellogg Company, Chemical Manufacturing Division, P. O. Box 469, Jersey City 3, N. J.

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Schematic sketch of the control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits, MC-3 has 3 circuits.



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spectively. Both of these raw materials are important for the production of plastics.

The Rheinische Olefinwerke has a capacity of 12,000 tons of polyethylene on the basis of petroleum refinery gases; a doubling of this production is planned. In addition, this plant also produces ethylbenzene, the raw material for styrene.

Another plant has been placed in operation at the Farbwerke Hoechst, which produces low-pressure polyethylenes by the Ziegler process. The ethylene is obtained in high yield from petroleum by the plant's own process (Hoechst Cokifier). No concrete information is available as yet with regard to the initial intended capacity or possible further expansions.

The Kohle-Ol Chemie G.m.b.H. will soon commence the construction of a polyethylene plant designed, for the time being, to produce 12,000 tons of polyethylene from refinery gases.

Expansion plans for polyethylene have been made known also by the Bergwerksgesellschaft Hibernia and the Chemische Werke Hüls, as well as by the Ruhrchemie A.G. Hibernia will shortly place in operation a pilot plant for the production of polypropylene.

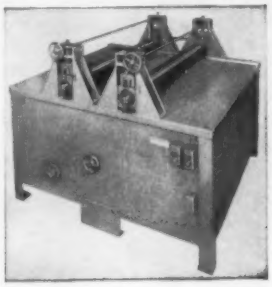
The Farbenfabrik Bayer will, during this year, establish a petroleum cracking plant at Dormagen which is to operate under a process which has been brought to industrial maturity by this company. This is the so-called "Fluid Bed Process," in which olefins are obtained in high yield.

Plastics processing

Germany has a highly developed plastics processing industry, the turnover of which was about 1 billion German marks in 1955. There are some 1000 companies which specialize in the processing of plastics and approximately 500 more firms which process plastics as a sideline.

In view of the large number of diversified products, the plastics industry is closely interwoven with practically all branches of industrial activity. A breakdown of the importance of the individual fields of use can be effected

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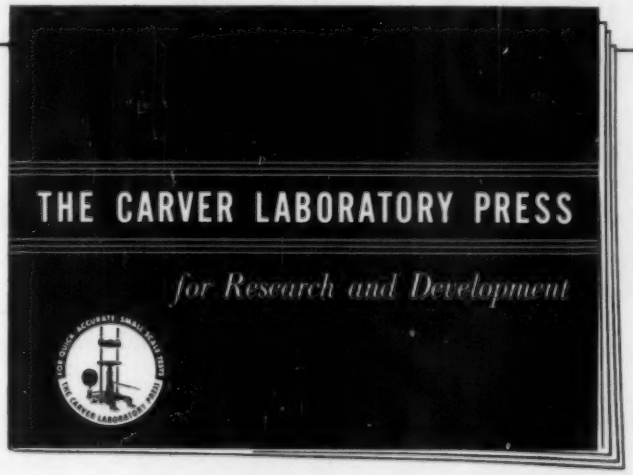
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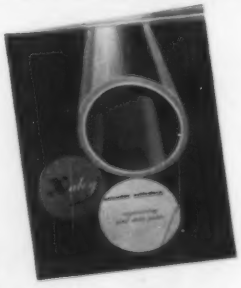
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only imperfectly on the data available. Based on a careful estimate, however, the following approximate picture is obtained for 1955, the figures representing percentages of the total plastics production value.

Electrical engineering	26
Machines and apparatus	6
Vehicles and ships	3
Precision mechanics and optics	5
Iron, plate, and metalware	1
Artificial leather and covering materials	20
Clothing and equipment	19
Household requirements	10
Combs, brushes, bristles, toys, office supplies, advertising articles, packaging	10
	100

The fact that firms in the German plastics processing industry are mostly of medium size is shown by the following figures from the employment records of the exclusively plastics processing companies:

85%	up to 50 employees
10%	with 100 to 500 employees
4%	with 500 to 1000 employees
1%	more than 1000 employees

Unfortunately, only very scanty data are available concerning the machine equipment of the plastics processing industry. Since 1948 new machines with a total value of about 100 million German marks have been set up. This does not include accessories or new and replacement parts.

Dependable statistics are available only with regard to new injection molding machines and extruders: 3400 injection molding machines have been set up since 1946; a total of about 4500 such machines are probably available today for the processing of plastics. While it is known that some 1300 new extruders have been set up since 1946, no dependable figures can be given for the number of extruders in operation today. More than 10,000 compression presses are probably in operation; the number of calenders in operation is estimated at about fifty.

It may further be mentioned that the German plastics processing industry has experienced, in the same manner as plastics production, an annual rate of growth of approximately 25 to 35% since 1951.—END

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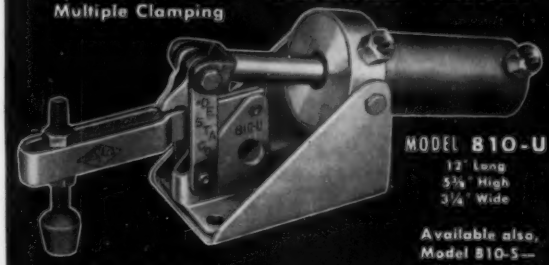
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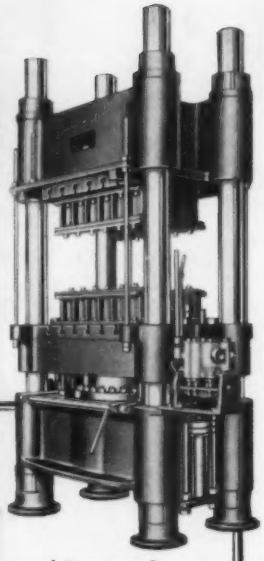
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Plastics for missiles

(*From pp.* 148-151)

sulfides. General Electric Co. has recently reported successful work with hydrogen peroxide and machined polyethylene rods. Performances of these materials are on a par with liquids.

In the liquid rocket, oxidant and fuel are stored separately in tanks and either pressure fed or pumped into the motor for combustion. Bi-propellant rockets use such oxidants as liquid oxygen, fuming nitric acid, or high strength hydrogen peroxide with alcohols, gasoline, kerosene, or other liquid organics (Figure 6, p. 151). Monopropellants include ethylene oxide and several alkyl nitrates.

The liquid rocket came into being some 60 years ago. The German V2, used during World War II, was a rocket of the liquid variety; it had a range of 125 miles. Today's liquid rockets have intercontinental ranges. By and large, the use of plastics in liquid rockets has remained small. Typical applications are as seals, liners, gaskets, expansion joints, insulators, and coatings.

The "front end"

Great emphasis is now being placed on the "front end" (guidance and control) of the missile. Although constituting only about 5 to 10% of the total missile weight, guidance represents about 50% of the total cost of a missile. Here plastics have been used to good advantage in preparing printed circuits; in elimination of heavy parts; in potting, encapsulation, and impregnation; and in dramatic reductions in total package size.

Other mechanical missile components being made of plastics include cams, gears, levers, and even structural assemblies.

Because certain areas of missiles are exposed to rather severe chemical attack from propellants and environmental conditions, plastics protective coatings have a wide open field.

Another challenge is the protection of structures in the "thermal barrier." As speeds increase, the frictional temperatures also increase. When an intercontinental ballistic missile re-enters the atmosphere at speeds of 10 to 20 times the speed of sound, the temperature may rise several hundred or even thousand degrees. One method of protecting the structural components would be to employ a coating that would burn away in layers.

An auxiliary but growing use of plastics in missiles is in tooling. Plastic tools are ideal in the missile field because of the large number of design changes usually made before a missile gets out of the test stage and into production. Also, many missiles have an unusually short production life because of the great advances being made in the field. And an especially attractive feature of the field is that the finished product is usually a "one-shot" affair. However, quality demands have to be high since the failure of a five cent part could ruin the performance of a highly complex and expensive assembly.—END

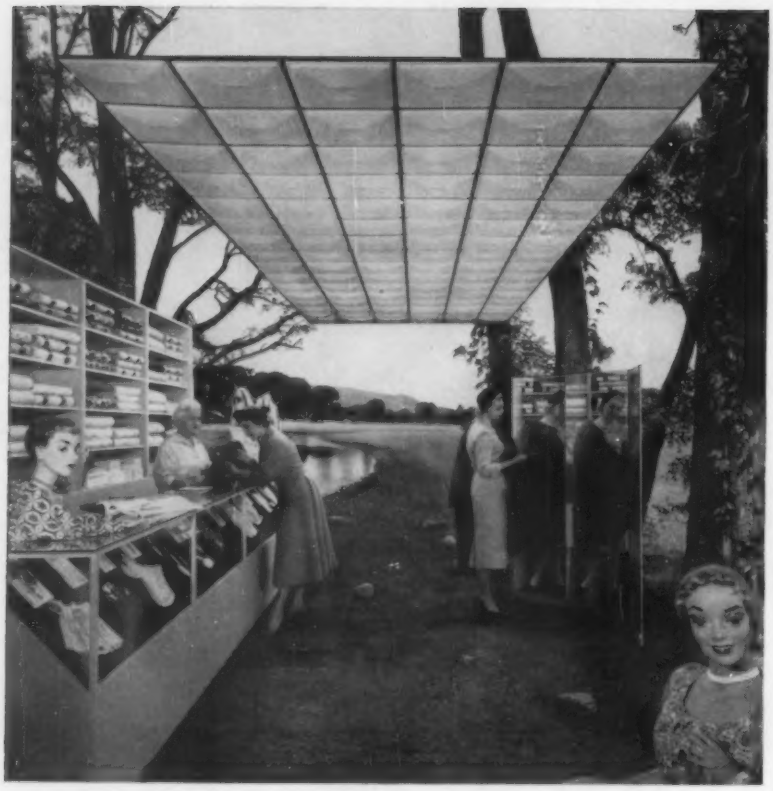
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Plasticizer production

(*From pp.* 144-146)

any one of a variety of the low-molecular-weight phthalate-type plasticizers.

Other phosphate esters, such as alkyl aryl, and cresyl diphenyl, and triaryl, are reported under the Tariff Commission's classification of "Other Cyclic Plasticizers." These figures show that these products have been finding increased use as plasticizers for vinyl film, sheeting, and foam, as well as plasticizers for such resins as cellulose nitrate and polyvinyl acetate.

Alkyl aryl phosphates combine fire retardance with acceptable permanence and low-temperature flexibility for many applications. Cresyl diphenyl phosphate types are used in preference to TCP because of better flexibility and because they also exhibit somewhat better light stability.

Sulfonamide plasticizers: Toluene sulfonamides represent a class of highly polar plasticizers. Because of this characteristic, these plasticizers have been found particularly valuable for applications involving such resins as cellulose acetate, polyvinyl acetate, polyamides, melamine, and phenolic.

Chlorinated biphenyls and chlorinated paraffins: Chlorinated biphenyls and chlorinated paraffins vary in properties depending upon the degree of chlorination and the starting raw material. These products are finding increasing use in applications such as polyvinyl acetate adhesives, cellulose hot melts and lacquers, and styrene butadiene compounds. They also find extensive use as secondary plasticizers for various polyvinyl chloride formulations.

Other miscellaneous plasticizers listed under cyclic compounds are synthetic camphor, tetrahydrofurfuryl oleate, and many others. Camphor is widely used in cellulose nitrate molding compounds and THFO finds acceptance as a secondary plasticizer in vinyl chloride. Other miscellaneous plasticizers, such as phthalyl glycollates, find use in non-toxic applications. Extender plasticizers which are derived from petro-



Pittsburgh Fiber Glass Chopped Strand is used as insulating material in this Erico CADDY Electrode Holder. Chopped Strand makes this product stronger, longer lasting, moisture resistant; eliminates warpage and lamination breakdown.

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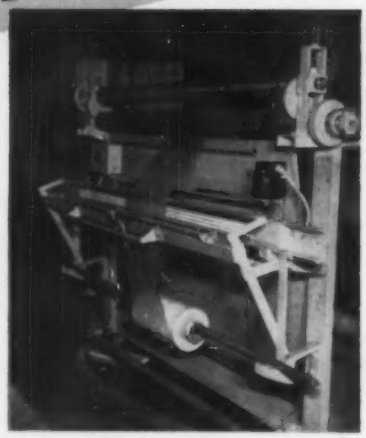
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leum are finding application as secondary plasticizers with many resins.

Acyclic plasticizers

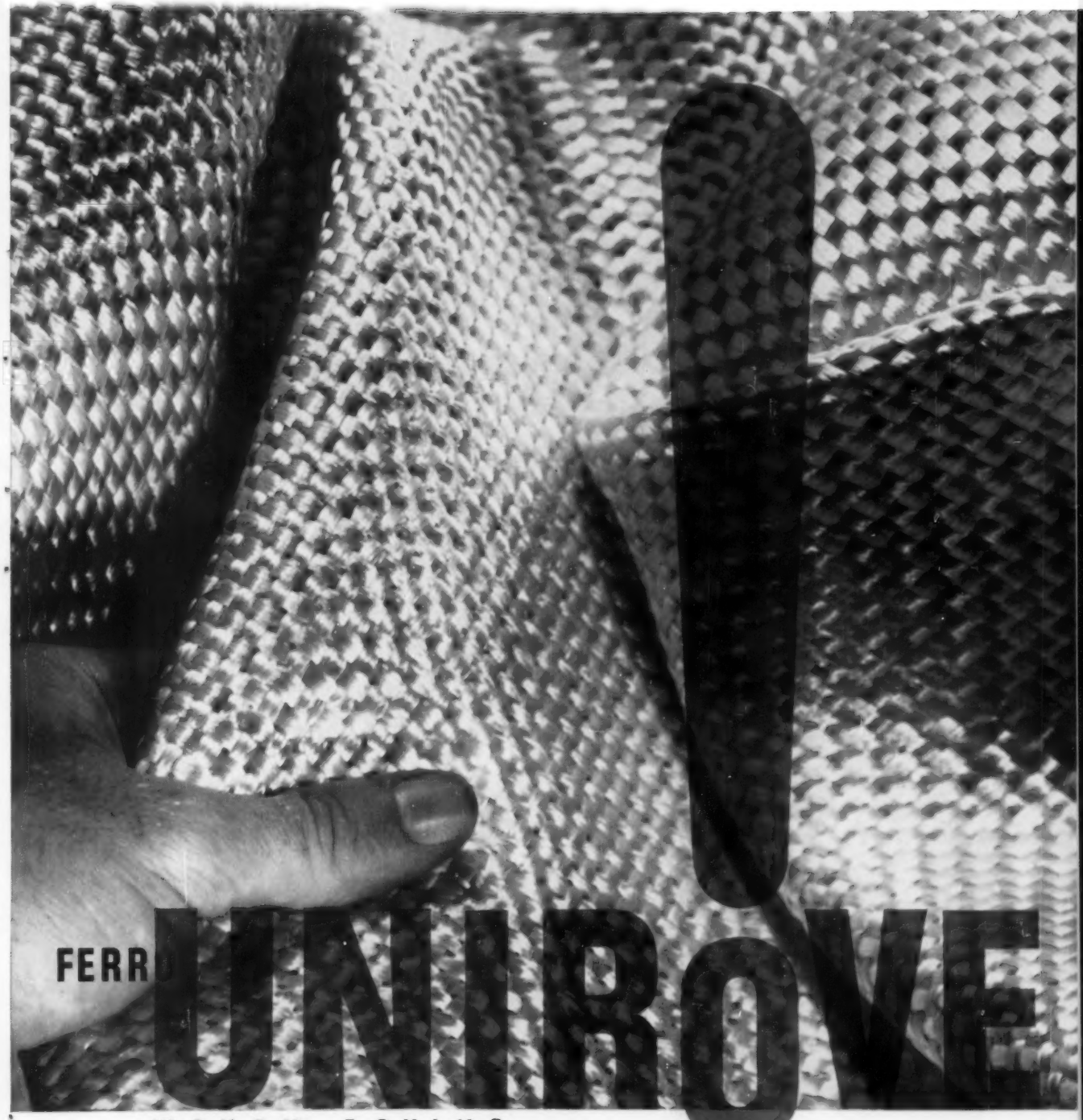
Adipic acid esters: Di (2-ethylhexyl) adipate and diisooctyl adipate are primarily used as specialty plasticizers to impart excellent low-temperature flexibility to vinyl and many rubber compounds. Their production has remained steady throughout the last several years. Growth in adipic acid esters is reflected by diisodecyl adipate which imparts remarkable low - temperature flexibility to both vinyls and rubber and also offers the advantage of much lower volatility. Based on current estimates, it seems likely that DIDA will continue to grow, perhaps at the expense of octyl adipates.

The other important adipic acid ester is dibutyl Cellosolve adipate which is primarily used as a plasticizer for polyvinyl butyral, the well known material going into the production of safety glass.

Unsaturated acids: The use of unsaturated acid esters, such as ricinoleates, in PVC has been consistently decreasing because of poor compatibility stability. Oleic acid esters have increased from 8.6 million to 12 million lb. in the past year. These materials are used primarily as plasticizers for cellulose nitrate and ethyl cellulose, with some sales as secondary plasticizers for cellulose acetate butyrate, vinyl acetate, and vinyl chloride.

Phosphoric acid esters: Sale of acyclic phosphoric acid esters has increased slightly in the past year. The major plasticizer here is trioctyl phosphate which finds application as a low-temperature plasticizer in PVC and as a fungus-resistant, flexibilizing plasticizer in vinyl coatings. Tributoxyl phosphate is used in cellulosics and vinyls and tribetachloroethyl phosphate as a flame retardant plasticizer in cellulosics and, in some instances, polyurethane foams.

Sebacic acid esters: Esters of sebacic acid used as plasticizers increased 3 million lb. during 1955. This increase was primarily in di (2-ethylhexyl) sebacate which found an important new



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application as a jet engine lubricant. It is also used in vinyls to upgrade flexibility without appreciable loss of properties, but is handicapped by a relatively high price.

Stearic acid esters: Stearic acid esters increased in 1955 over 1954 but did not reach the 1952 volume. This was primarily due to a reclassification of listings which was instituted by the Tariff Commission with much of the stearic acid ester production being classified for uses other than as plasticizers in recent years. The major fields for dibutyl stearate and others are as plasticizers in cellulosics, with some sales to vinyl acetate and polystyrene applications.

There are some interesting developments in stearate plasticizers if stabilizing plasticizers such as isooctyl epoxy stearate are included here. It seems likely that the importance of such products will increase in the future. It is difficult to know where to classify these plasticizing stabilizers; although they are listed as stearates at the present time, they are actually produced from unsaturated oleic acids.

Polymeric plasticizers: In 1955 the polymeric field rose to approximately 30 million pounds. These plasticizers find wide acceptance in cellulose nitrate, polystyrene, and rubber applications where permanence and resistance to heat and extraction are important. Major applications for polymeric plasticizers include high-temperature insulation, coated fabrics, and pressure-sensitive tapers.

Other acyclic plasticizers: Other acyclic plasticizers, consisting of esters of citric, azelaic, palmitic, tartaric, and ricinoleic acids, are finding use today in a variety of plasticizer and lubricating applications.

Predicting the future of plasticizers is indeed difficult, but judging from what the industry has introduced in the way of new experimental products, it is quite probable that in the near future new plasticizers will reach the market that will not only help broaden the scope of plastic products but will improve their physical properties.—END.



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Runner and gate

(*From pp. 166-172*)

higher-than-usual share of the total drop will occur across the gate.

Since everything that goes through the runner must go through the gate at the same rate, Q is the same for both Eqs. 1A and 2A. One may be divided by the other and the result solved for the ratio of the pressure drops to give

$$\frac{\Delta P_R}{\Delta P_G} = \left[\frac{38.4\ L^2\ wh^5}{\pi\ D^6\ t^2}\right]^{\frac{1}{3}} \quad \text{Eq. 5}$$

where the subscripts $_R$ and $_G$ refer to the runner and the gate. Substituting the sample values for the different dimensions, the ratio for this case is

$$\frac{\Delta P_R}{\Delta P_G} = \left[\frac{38.4\times10^2\times0.080\times(0.020)^5}{3.14\times(0.250)^6\times(0.080)^2}\right]^{\frac{1}{3}}$$

$$= 2.93$$

Thus the drop along the runner is almost ¾ of the total! If this rather restricted gate were opened, i.e., if h or w were made larger, or t shorter, this ratio would increase even further. On the other hand, to get a large share of the drop occurring over this gate, say 80%, would require a runner diameter of 0.86 in., a much fatter runner than most molders would consider using: the runner volume would be almost 6 cu. in., or twice the cavity volume, and at least ⅔ of the machine's output would have to be reground.

Growing emphasis is being placed on the importance of filling cavities rapidly, particularly when the sections are thin, to produce stress-free parts. From this standpoint it would be nice if the runners offered no resistance at all so that the full melt pressure could be felt at the gates. However, it is plain that this desire is in direct conflict with economy of rework as well as with fast sealing of gates.

From Eq. 1A it is apparent that, for a given flow rate, the pressure drop is proportional to the runner length, so it helps a good deal to keep runners as short as possible, within the limitations of the job and SS. A method for reaching a satisfactory compromise will be proposed in the second part of this article. Meanwhile, where very fast filling is needed for large-area, thin sections, increasing the runner diameter substantially may be the only practical way of doing the job. Certainly a tremendous increase in filling rates can be realized by doing that, whereas opening the gates, which is not desirable anyway, cannot increase rates by more than a factor of two in runner-gate systems having dimensions in the approximate neighborhood of those outlined in the example above.

Conclusions

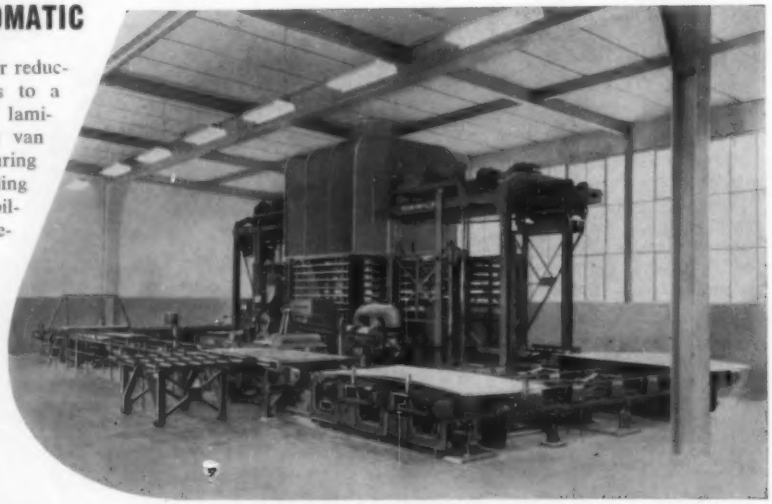
1) Runners and gates designed to achieve "successive simultaneity" (SS) are the best guarantee of uniform filling of all cavities and of inter-cavity uniformity of product properties and dimensions.

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2) SS is best achieved, when cavities are identical, by making the gates identical and by laying out the runner paths so that all the cavities are supplied by runners having a branch-to-branch correspondence in length, diameter, and number of cavities served. The "organization-chart" (OC) runner layout provides this correspondence. OC layout or close approximations to it can be successfully worked out for most jobs.

3) With OC runner layout and identical gates, SS is achieved regardless of the relative size of runner and gate.

4) To accomplish SS, close tolerances must be held on gate depth and length and on runner diameters and lengths.

5) In present-day runner-and-gate systems, even with restricted gates, the larger share of the available melt pressure is expended in the runners. Ten-fold increases in filling rates can be obtained with restricted gates by opening the runners enough, at an increased cost in handling rework.

The second part of this article, now in preparation, will show how to find gate dimensions for a given cavity size and molding material. Cavities of assorted volumes will also be discussed.

Acknowledgment

This article grew out of discussions with L. Paggi, R. E. Gee, and C. H. Jepson of Du Pont's Polychemicals Dept., and with H. Schwartz of Empire Brushes, Inc. The editor deeply appreciates the help they gave.

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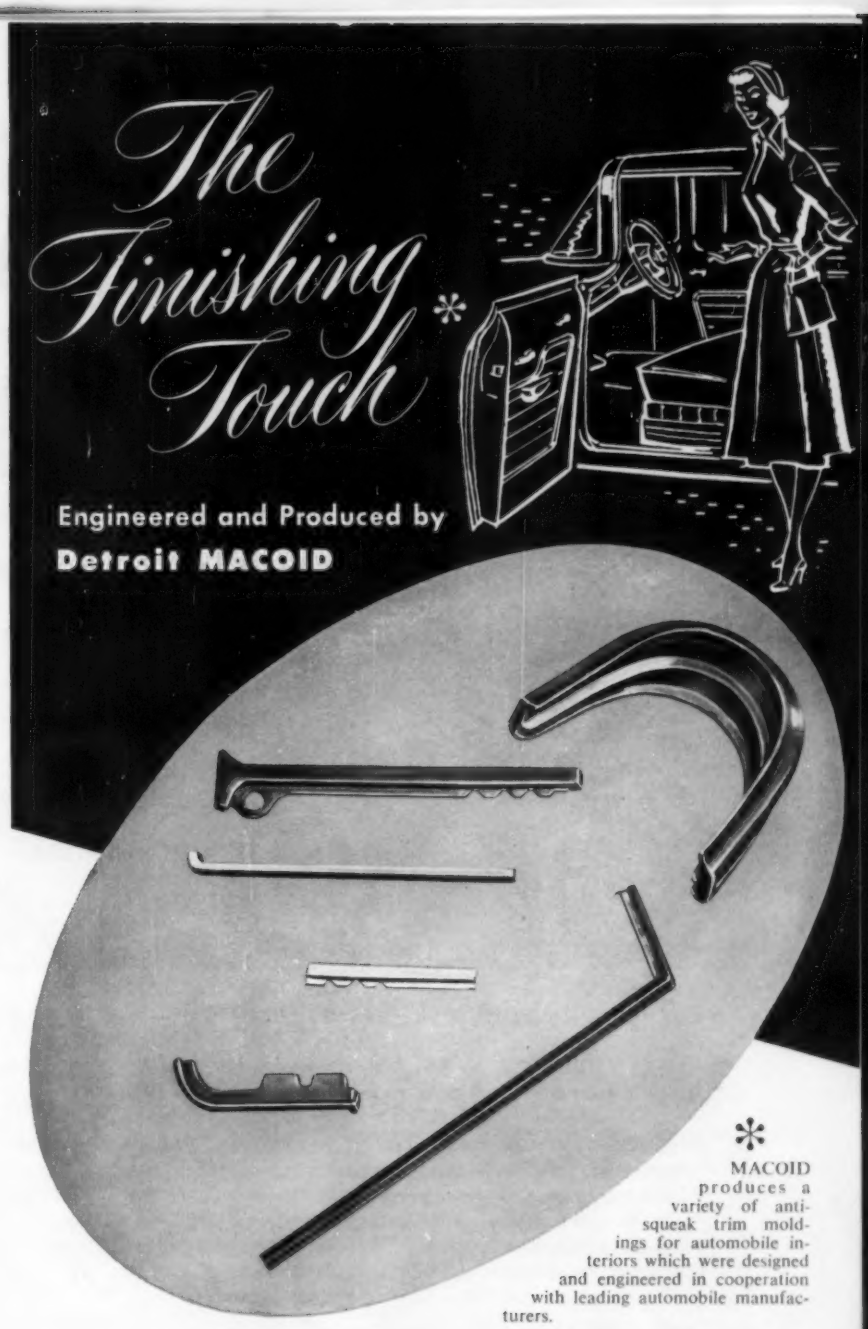
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Polysulfide epoxy

(*From pp.* 187-204)

mersion in solvents and water. Reduced shear strength at elevated temperature is the primary disadvantage of the liquid polysulfide polymer-epoxy adhesive.

Preliminary studies show that polysulfide-modified liquid-solid epoxies make improved adhesives.

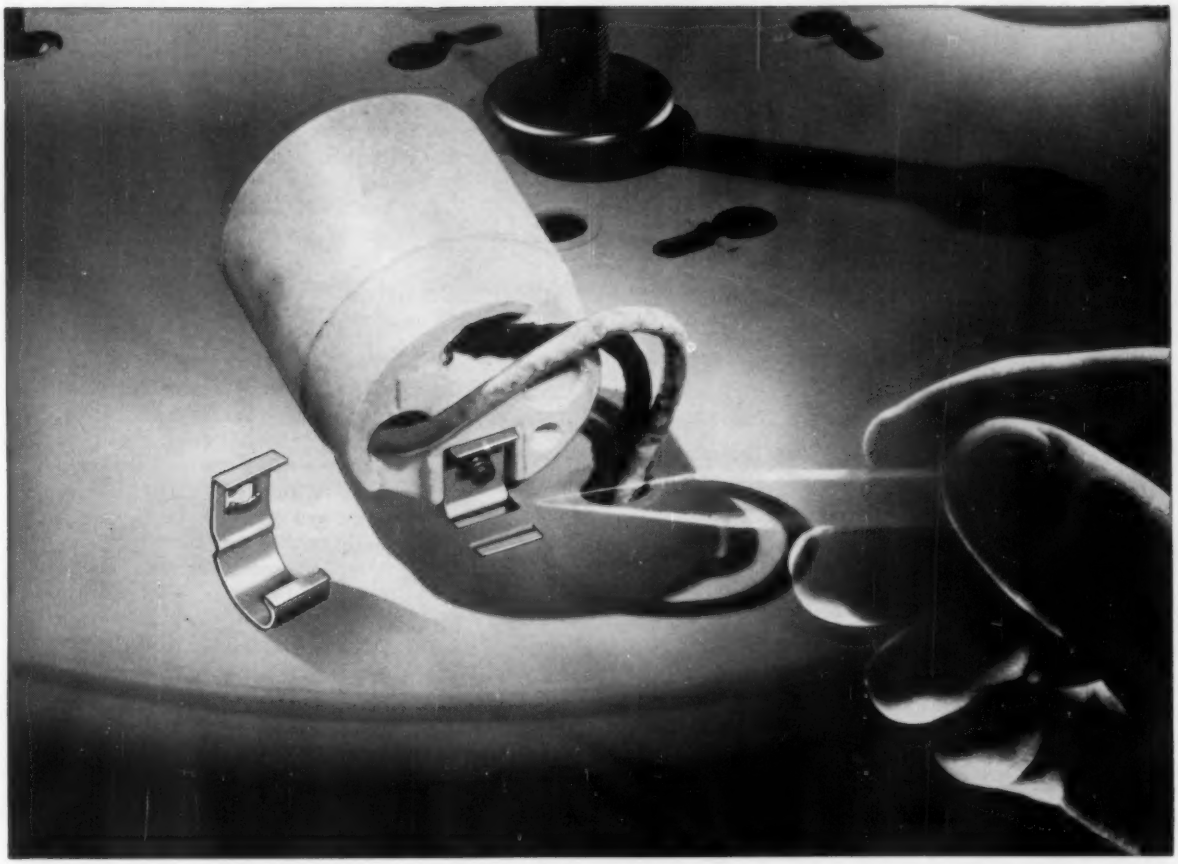
The effect of modifying epoxy resins, such as Epiphen ER-823, with various amounts of liquid polysulfide polymer on the shear and bend strengths of the adhesive is graphically illustrated in Fig. 3, p. 204 (9). These adhesives were cured with 10 parts of amine EC-1 (The Borden Co.) per 100 parts of epoxy resin for 1 hr. at 230° F. The bend and shear strengths of the adhesive at 75° F. are tripled and doubled, respectively, by the use of polysulfide polymer.

In Table XIV, p. 203, a comparison is made of the shear and bend strengths of a resorcinol-modified epoxy adhesive and a similar adhesive containing liquid polysulfide polymer (7). Adhesive FPL-852a, flexibilized with 20 parts, by weight, of polysulfide polymer, gave improved shear strengths when cured at 80° F. In addition, the shear strength tested at 250° F. was not greatly reduced when the bond was cured at 200° F. for 1 hour. Bend strength was markedly improved by the use of a polysulfide modifier.

Shear strength as a function of test temperature for a polysulfide-epoxy adhesive, a polysulfide-resorcinol-modified epoxy adhesive, and a commercial epoxy adhesive is shown in Figs. 4 and 5, p. 204 (7). Formulations for the experimental adhesives are given in Table XIV. The hypothetical curves show the superior shear strengths obtained with the polysulfide-epoxy adhesive FPL-828 over a wide temperature range when cured at 80° F. With a cure of 1 hr. at 200° F., epoxy adhesive FPL-852a modified with liquid polysulfide polymer and resorcinol resin developed good shear bond strength at 250° F. Except at 250° F., the polysulfide-epoxy adhesive not modified with resorcinol possessed good shear strengths. Shear tests were conducted after an exposure of approximately 3 to 5 min. at elevated temperature.

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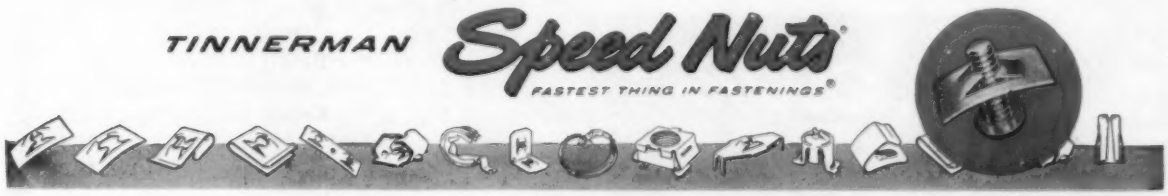
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(*From page 208*)

manufacturer: Short-time internal pressure test with water or air. Proof test: 1.5 times nominal pressure. 3) *Acceptance test:* Bursting pressure in 3-min. test at 20° C.

The recommended *minimum wall thickness* of all plastics pipes shall be computed from the Naday equation:

$$s = \frac{p \cdot d_m}{2\sigma} = \frac{p \cdot d_a}{2\sigma + p} = \frac{p \cdot d_i}{2\sigma - p}$$

where p = nominal pressure, d_m = average diameter, d_a = outside diameter, d_i = inside diameter, and σ = recommended allowable stress at 20° C.

The following recommendations were made for rigid PVC pipe.

The recommended maximum allowable stress was proposed to be specified as σ_{max} = 60 kg./cm.² at 20° C., but this will be given further study.

The minimum wall thicknesses, *s*, for rigid polyvinyl chloride pipe as computed by the aforementioned Naday equation and rounded off to standard values are given in Table I, p. 208. It was decided that the minimum wall thickness shall be 1 millimeter. It was suggested that the figures given in Table I be made the basis for further study.

It was proposed that the following tolerances should form the basis for further investigations and that they should be checked also for use in fittings:

1) Tolerances for wall thicknesses: +0.2 mm. +0.1 s; −0. This computation results in the following tolerances:

Minimum wall thickness	*Tolerance*
mm.	*mm.*
1 to 1.8	+ 0.3
2 to 3.75	+ 0.4
4 to 7.5	+ 0.6
8 to 12	+ 1

2) Tolerances for outside diameter when the circumference of the pipe is measured: + 0.3 mm. + 0.015 × d_a; −0.

3) Tolerances for the mean outside diameter: + 0.2 mm. + 0.1 × d_a; −0.

The mean outside diameter is the arithmetic mean of two outside diameters measured perpendicular to each other.

In compliance with the general considerations for the standardization of plastics pipes the following details were proposed for flexible ("high pressure") polyethylene pipe:

It was suggested to specify a *maximum allowable stress* of σ_{max} = 30 kg./cm.² at 20° C. It was further proposed to study the possibility of rounding off the minimum wall thicknesses, *s*, as computed by the Naday equation, to standardized values, and to specify a minimum wall thickness of 1.6 millimeters.

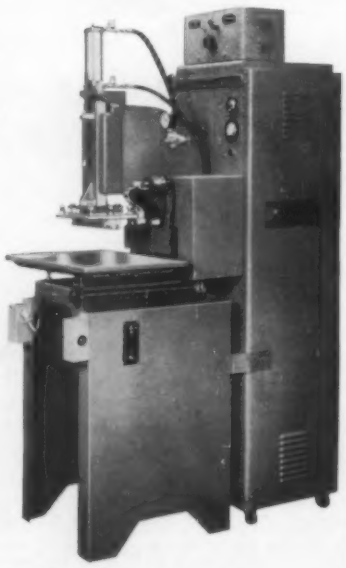
It was further proposed to study further the following:

1) Tolerances for wall thicknesses: + 0.2 mm. + 0.1 s; − 0.

2) Tolerances for the mean O.D.: +0.2 mm. +0.03 d_a; −0.

Until further investigations are made, it was proposed that the maximum allowable stress for rigid polyethylene pipe be σ_{max} = 50 kg./cm.² at 20° C.—End

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 45)*

New plateau for plastics

High-pressure processed high-density polyethylene and polypropylene have been in the spotlight for the past several months. (See Plastiscope, MODERN PLASTICS *33*, 45, Sept. 1956). The recent High Polymer Symposium at Notre Dame University, South Bend, Ind., added fuel to a fire that has been burning brightly behind a screen in the research departments of chemical companies all over the world. The symposium was enlightening, but there is still much to learn and several years will elapse before the significance of the factors behind the development of these new materials will become completely apparent to the industry.

The announcement that Montecatini of Italy was producing polypropylene with isotactic polymers in pilot-plant quantities and was seeking licensees throughout the world was perhaps the match that set off this flaming interest in polypropylene and in a stereospecific system for producing tailor-made plastics.

Potentially low in cost—Polypropylene has long been discussed as a material with properties similar to polyethylene but with greater stiffness and heat-resistant properties. There was never much doubt but that some day the producers of low-pressure processed polyethylene would at least try their hand at producing polypropylene. Montecatini was the first to announce this accomplishment. Ziegler, Phillips, and Standard of Indiana (principals and many of their licensees) are believed to have at least laboratory experience in the production of polypropylene.

Development of the Montecatini polypropylene is in great part credited to the research work of Prof. Guilio Natta, famous high-polymer chemist, who also coined the word "isotactic" to describe the highly crystalline steric structure or spiral formation of the closely packed molecules of the material. The word derives from the Greek "isos" meaning the same, and "tato" meaning a regular order. This means that there are no branches, knobs, or knurls sticking out from the molecules and thus they can be more closely packed together.

Scientists have known that propylene could be polymerized by the new organo-chemical catalyst system ever since its discovery, but there has been doubt about the practicality of doing so. It seems that when propylene is polymerized the isotactic portion may be anywhere from 50 to 80% of the product and the balance a useless amorphous substance. Therefore, processing cost was unreasonably high. If Prof. Natta's findings are correctly interpreted, they indicate that he has developed a formulation in which the isotactic proportion is not only high (perhaps 80%), but it is unnecessary to remove the amorphous portion since it doesn't affect the properties of the propylene polymer to any considerable extent.

Cost still is a question—The price of Montecatini's pilot plant polypropylene has been declared at 43¢ in Italy—the same price as polyethylene made in that country. What the permanent price may be when and if polypropylene becomes a large-scale commodity is at this time purely a matter of speculation.

Most of the propylene produced in refineries today is burned as a waste product. But if plants are built to produce it from a petroleum stream, the cost would probably be around 4¢, according to qualified estimators. Ethylene monomer sells today for about 5 cents. However, the monomer cost for both polypropylene and polyethylene is generally considered less important in the final price of a polymer than the cost of processing.

By this time everyone knows, for example, that the cost of constructing a high-pressure processing plant for conventional polyethylene is extremely high, but once the plant is in production the operating costs are moderate. On the other hand, the cost of building a plant for low-pressure processed polyethylene is modest, but the production cost is not yet established. There are many engineers who believe that the cost of removing catalyst, unpolymerized monomer, and solvents is so high that so-called low-pressure polyethylene will always be a few cents higher than high-pressure polyethylene.

Difficulties with catalysts—In the Ziegler system, it is difficult to remove the catalyst; in the Phillips system, there is reportedly only a 2 or 3% concentration of polymer in the solvent after polymerization. Proponents of these two systems insist that too much emphasis has been placed on the potential costs of their production methods. Polyethylene users have adopted a "wait and see" attitude. They also have their eyes set on the new higher- or intermediate-density polyethylenes made in the conventional high-pressure plants, which have properties approaching those of low-pressure polyethylene and polypropylene. These intermediate-density materials sell at a few cents more per pound than conventional polyethylene.

Probably several years will elapse before a comparative price scale can be set for all the various polyethylenes and propylene. The rise in the price of Koppers' Ziegler-type polyethylene from 43 to 47¢ last spring is probably not permanent, but simply the customary result of problems involved in developing a new ma-

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The Plastiscope

terial. By the end of 1958, there should be a considerable quantity of Ziegler and Phillips polyethylene available in the United States, and the price situation will then be more determinable.

Properties of polypropylene—Properties of the Montecatini polypropylene are most interesting. The melting point is reported to be 320° F. compared to a range of from 214 to 270° F. for all the various polyethylenes. Molded pieces are stiffer than polyethylene, are harder, and have better scratch resistance. Polypropylene is easy to mold but sensitive to oxidation, according to a European who is familiar with late developments in this field. On the other hand, it may possibly be stabilized to prevent oxidation. Critics also contend that polypropylene is likely to have considerable cold flow.

Samples of film so far shown do not have as uniform a surface as polyethylene and are likely to contain fisheyes, but such defects will probably be overcome in the future. A very strong fiber can be made from propylene and the material may be headed primarily in that direction, but little is yet known about its shrinkage characteristics and whether or not it can be successfully dyed or will have the kind of "hand" that textile producers demand.

Difficult hurdles—The possible problems involved in polypropylene development as mentioned here are in no sense given to discourage thoughts of its possible prosperous future. Every new material has had to leap over difficult hurdles. It is probably just as true that polypropylene in commercial quantities will be with us some day as it is true that butterflies will continue to develop from caterpillars, but it will take time and great expenditures of cash for more research and development before it becomes a widely used plastic material.

High-polymer experts in the United States, such as Frank D'Alelio and Herman Mark, point out that it isn't necessarily the materials that are important; it is the stereospecific system by which they are produced which will move the plastics industry up to a new plateau. This system, which uses organo-chemical catalysts as a principal tool to more or less replace high pressure in a polymerizing process, can be used to tailor-make plastics according to a predetermined geometric form of the molecule and thus to develop properties needed for a specific application. This doesn't mean that the new plastics will necessarily replace older plastics any more than aluminum or titanium replaced iron and steel, but it could mean that plastics useful for structural purposes now deemed impossible may be obtainable at some future date.

Incidentally, it is interesting to note that the amount of aluminum required to polymerize olefins by the Ziegler system is estimated at 1 lb. of aluminum for from 500 to 2500 lb. of polymer. Many other metallic chemicals are also used, but estimates are not available.

Materials that have been catalyzed—So far, the principal materials handled in this new catalyst system are the olefins, such as ethylene, propylene, butadiene, butylene, and pentene, but Prof. Natta has also polymerized styrene to obtain a material with a melting point of 445° F. Vinyl chloride or vinyl acetate can't be handled because they contaminate the catalyst, but Dr. D'Alelio believes that the day will come when other catalysts or ion exchange systems will be developed that will stretch today's conceptions far beyond current thinking.

There are many interesting facets connected with or related to this stereospecific development. One is that scientific literature and patents cite several references to formulations containing isotactic polymers made in the laboratory although not called by that name. But the literature doesn't tell whether or not they were made with surface-acting catalysts such as the organo-chemical catalysts described above. Another curious angle is that an old Du Pont patent (2,220,930) describes a polyethylene with a density of .993. Ziegler polyethylene density is of the order of .950 to .960. It is strange that such a patent seems to have been overlooked by the hunters for high-density polyethylene.

But the bombshell dropped on the industry by I.C.I., Du Pont, and Spencer when they announced their new intermediate-density polyethylenes (.930 to .940) that are produced in present high-pressure plants by undisclosed methods is the most interesting of all. This higher-density, high-pressure processed polyethylene approaches the properties of high-density, low-pressure processed polyethylene. It may well move into applications that some processors reasoned could be reached by copolymers of ethylene with propylene, butylene, and other olefins since copolymerization of ethylene with these olefins would produce a softer, more flexible material that might be more suitable for film and other special types of applications than presently known low-pressure polyethylene.

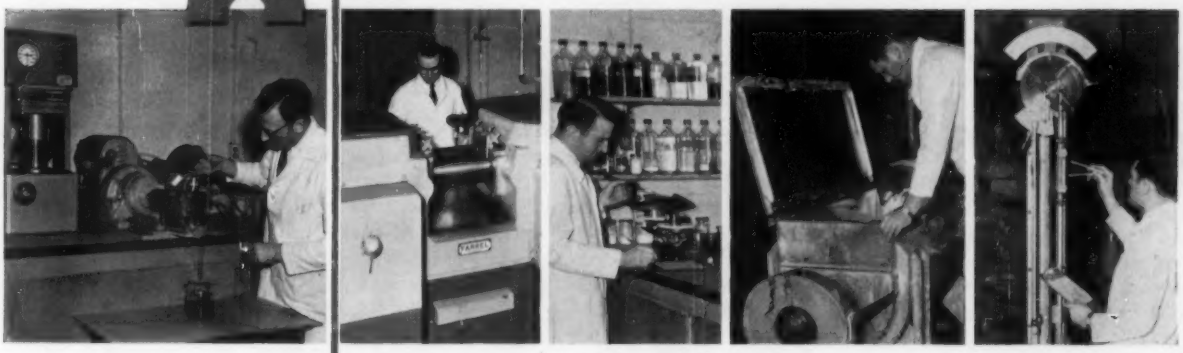
New methacrylate resin

Improvements in methyl methacrylate resins, together with price reductions, focus more and more attention on the possibilities of this material for absorbing an ever-increasing share of the plastic industry's business.

The last publicly announced improvement was Lucite 140 molding powder which Du Pont tests indicate will retain stability at 20 to 30° F. above the maximum of other methacrylate resins. This means that the temperature of the injection cylinder can be maintained up to 40° higher than formerly—which gives a wider working temperature range—and that the molder can now worry less about overheating. Also, the molten material is more liquid and therefore flows better and faster.

Among other advantages are

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The Plastiscope

the fact that the higher flow permits reduction of pressure on the ram or, conversely, that more cavities can be filled with a given ram pressure, leaving little or no flash, thus reducing scrap and the cost of finishing molded pieces. Faster flow also helps in producing a better surface on the fininshed product because the mold fills faster and therefore the material temperature from one part of the mold to another is more uniform. This also means that weld lines can become less prominent because temperatures of surfaces or edges which meet during injection are more nearly the same.

In some cases, a reduction in molding cycle of from 15 to 20% is reported when using the improved Lucite 140. For example, a 7-oz. tail light lens in a three-cavity mold was molded in 70 sec. in the new 140 compared to 84 sec. with the older Lucite. In another example—a long, thin tail light—the piece splayed at 460° F. in the old material, but in the new the temperature of the methacrylate was held at 510° F. without resulting in a splayed molding.

Up to now, the new 140 has been used largely in automotive parts since that is the largest segment of the methacrylate molding industry and presently is showing marked activity after a painfully slow period earlier in the year. But it is believed that the new material will be equally useful for the customary methacrylate moldings, such as orange juice dispenser parts, paper weights, jewelry, hand mirror frames, brush backs, and instrument panels. Investigatory work is suggested for such items as telephone hand sets, knobs, venetian blinds, tumblers, tape recorder reels, transparent housings, and compression molded signs.

There has not been much work done in extrusion of the new material, but 140 sheet for vacuum forming should have desirable properties because of its higher heat stability. In one experimental comparison, an extruded sheet of the new material vacuum formed into a display rack gave a good clear, smooth result compared to the bubbly or grainy surface of the older material, caused by depolymerization during the processing.

The new Lucite 140 eventually may completely replace the old formulation, but both will be continued indefinitely among Du Pont's 12 different types of methacrylate resins. The price of both is the same—55¢ a pound.

General Tire expansion

Capacity of The General Tire Co.'s 18-month-old vinyl chloride plant at Ashtabula, Ohio, is being increased by 50%; former capacity was 25 million lb. a year. P. J. Wallace, with the company since 1943, is the new plant manager. General's Plastics Div., including its four processing plants, exceeded $70 million in 1955.

General also announces Vygen 2201, a new modified rigid polyvinyl chloride compound for calendering. The company asserts that the new material does not possess the disadvantageous rubbery nerve frequently found in rubber-resin blends and has a minimum of heat build-up during processing. A 30-mil sheet can be drawn to a depth of 9 inches. General now produces an all-purpose vinyl, a dry blend resin, an extrudable rigid vinyl, a butadiene-styrene-vinyl pyridine latex, and a styrene-butadine latex for paint.

Disposable ice cream dishes

One of the largest and most successful national ice cream chains in the country, Carvel Co., Yonkers, N.Y., has switched to disposable vacuum formed dishes for sundaes and banana barges (glorified banana splits).

The dishes are formed of 20-mil polystyrene sheet, especially compounded and extruded by the molder. The sundae dish is 4¼ in. sq.; the banana barge dish is 4½ by 9 in.; and both are a little less than 1 in. deep. They come in a variety of molded-in colors, corresponding to various ice cream flavors served in them.

These dishes were introduced on a trial basis a little over a year ago in several locations and have proved so successful in boosting ice cream sales that the company is now using them almost exclusively in all of its 700 franchised stores and plans to use them in any that it opens in the future (at the present time Carvel is adding several stores a week to the chain).

Cost of the vacuum formed dishes is only a fraction of a cent higher per dish than the cost of the waxed paper dishes they replace; at the same time, according to company officials, an increase of over 22% in the sale of ice cream is directly attributable to their use.

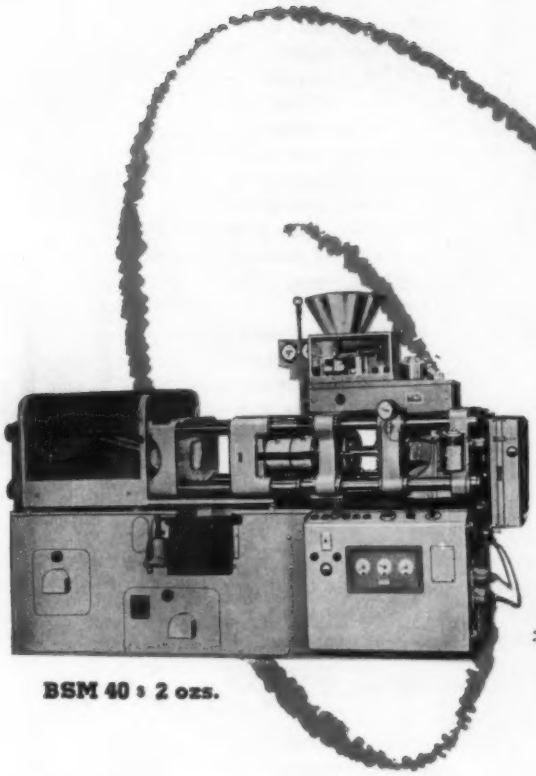
Carvel is currently buying vacuum formed banana barges in quantities of 800,000 and sundae dishes in quantities of 1.5 million. The dishes are molded at a rate of 30,000 per machine per 8-hr. shift.

While the dishes fall into the category of disposables, they have a certain re-use value which makes them attractive to the buyer. They can be used to store small household items, to mold desserts, and for other purposes. In addition, they are stronger than the paper dishes formerly used, have integral color, do not absorb moisture, make storage easier, and present no breakage problem.

Dow's new fiber

Plans for commercial production of a new synthetic textile fiber have been announced by The Dow Chemical Co., Midland, Mich. The staple fiber, developed by Dow research men, will be marketed under the tradename Zefran. Company directors have approved immediate construction of a plant to make Zefran near Lee Hall, Va., on the James River.

Dow states that Zefran, a nitrile alloy, combines the ease-of-care properties of synthetic fibers with



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the exceptionally versatile dyeing characteristics of cellulosic fibers such as cotton or rayon. The material will be of interest to manufacturers of most classes of textile goods, including work clothes, play clothes, suitings, and other apparel fabrics, draperies, upholstery fabrics, and heavy industrial fabrics.

Arthur E. Young, formerly assistant manager of the Plastics Dept., has been named manager of the new Textile Fibers Dept. He joined Dow in 1937 and entered research in the development of cellulose products and in the then relatively new field of synthetic coating materials. Mr. Young was manager of Coatings Technical Service before his appointment as assistant manager of plastics in 1950.

Package design competition

Twenty-one experts in various aspects of packaging and merchandising have been selected by the Package Designers Council to name winners in its third American Package Design Competition.

Results of the competition will be announced at a presentation luncheon next February at the Plaza Hotel, New York, N. Y. Award and honorable mention certificates will be presented to the designers of top-ranking packages in 20 categories representing every major industry.

Deadline for receipt of entries is November 1. Full information may be obtained from the Package Designers Council, 12 E. 32nd St., New York, N. Y.

Arc-resistant phenolic

An arc-resistant phenolic molding compound, designated Durez 18001 Black, has been introduced by Durez Plastics Div., Hooker Electrochemical Co., North Tonawanda, N. Y. The compound is a two-step mineral- and flock-filled material designed to provide arc resistance of 120 sec. plus high impact strength.

Prepared in small nodular form, Durez 18001 is a free-flowing material for preforming and for use on automatic molding machines.

The company claims that the dimensional stability is outstanding for a material of its type, with low water absorption and high dielectric strength. It evidences less preform weight variation, more uniform preheating and is dust-free.

Plastics Research Institute T.N.O.

The tenth anniversary of the Plastics Research Institute T.N.O., of Delft, Holland, is now being observed. The institute, started with a staff of about 10, currently employs nearly 180 people, including some 20 graduates. The total number of T.N.O. employees working on plastics runs even higher because in the Central Laboratory T.N.O about 55 persons are engaged in basic research in the field of high polymers.

Plastics Research Institute T.N.O. serves the Dutch plastics industry as a center of information, as a consultative body, and occasionally as an extension for research facilities. The Technological Dept. carries out research sponsored by the industry as well as its own research in the field of materials and processing methods. The editorship of the Dutch periodical *Plastica* and the organization of plant excursions and courses and lectures on plastics are also handled by the institute. The Testing and Analytical Dept. of the institute takes part in the standardization of plastics products.

Acrylic sheets now available in small quantity

Extruded acrylic sheet in any quantity from one sheet up can now be ordered for immediate delivery from Cadillac Plastic & Chemical Co., Detroit, Mich. Complete stocks in clear and standard colors will be maintained at warehouses in Detroit, Chicago, St. Louis, Milwaukee, Los Angeles, and San Francisco. (For non-standard colors, a 1,000-lb. minimum order requirement remains.) Standard thicknesses are 0.060, 0.080, 0.100, and 0.125 in.; stock width is 49 in., lengths as desired.

According to the company, the extruded acrylic sheet has a high degree of clarity, is free of internal strains, and shows no extrusion lines or blemishes. It can be thermoformed and has good weathering characteristics. It holds close thickness tolerances and gives minimum shrinkage at forming heats.

Cadillac, long a distributor of thermoplastics sheet, rods, and tubes, entered the manufacturing field in 1952 with the purchase of Du Pont patents and licenses for the production of cast acrylic rods and tubes and has now entered the extrusion field so that a customer may order either cast or extruded sheet. The firm also manufactures acrylic castings, pearlescent cast acrylic sheets, and extruded acrylic rods and tubes.

Vinyl to steel

A new product, combining the structural strength of steel with the rich decorative effects of vinyl in an almost limitless variety of colors and textures, has graduated from the research laboratory and is now in experimental production at U. S. Steel Co.'s Irvin Works in Dravosburg, near Pittsburgh, Pa.

Cold-reduced sheets are coated with liquid vinyl to produce tough-surfaced sheet of beauty and durability. It promises new decorative effects and long service in such equipment as refrigerators, radio and TV cabinets, wall panels, automotive bodies and trim, stove and heater parts, railroad coach, club, and sleeping car interiors, and office and home furniture.

In the process of manufacturing, the steel is surface-treated to improve its bonding qualities. Then a specially compounded adhesive is applied to the top surface and cured by heating. After air cooling, the steel enters a coating chamber where the vinyl

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is applied to the adhesive-coated surface. Again, heat is applied to solidify the plastic. Prior to cooling, the vinyl coating is embossed to obtain the desired design or texture. The finished product is stacked by a magnetic piler.

The pilot plant facilities at the Irvin Works will produce 18- to 28-gage sheets, 24 to 52 in. wide. The semi-commercial product is being offered for sale on a developmental basis.

Sandwich panels

Inauguration of a one-year study of structural sandwich panels has been announced by the Massachusetts Institute of Technology, Cambridge, Mass. The study, made possible by a grant-in-aid from Monsanto Chemical Co., is to be concerned with costs, characteristics, and possible uses of panels by the building industry.

Manufacturers of sandwich panels will be invited to appear at conferences at M.I.T. and also to furnish materials.

Write now if you have a complaint

Public Law 934, approved August 2, 1956, provides additional time for the Tariff Commission to complete the review of the customs tariff schedules authorized by Section 101 of the Customs Specifications Act of 1954. As matters now stand, the Tariff Commission is making a comprehensive study of the laws of the United States prescribing the tariff status of imported articles and will submit to the President, chairmen of the Ways and Means Committee of the House of Representatives, and the Finance Committee of the Senate not later than March 1, 1958 a review and consolidation of these laws which, in the judgment of the Commission, will to the extent practicable establish schedules of tariff classifications which will be logical in arrangement and terminology and adapted to the changes which have occurred since 1930 in the character and importance of articles produced in and imported into the United States and in the markets in which they are sold; eliminate anomalies and illogical results in the classification of articles; and simplify the determination and application of tariff classifications.

The Commission again invites importers, domestic producers, customs brokers, and other interested parties to submit any suggestions which in their opinion may accomplish the purposes above indicated. The Commission is finding that suggestions previously submitted are most helpful in this undertaking, and additional suggestions will be appreciated. Suggestions should be in quintuplicate and should be addressed to the General Counsel, United States Tariff Commission, Washington 25, D.C.

Plastics symposium

The fourth engineering institute in the field of plastics will be held on the campus of the University of Wisconsin, Madison, Wis., on October 18 and 19. The general theme will be "Plastics: Application in Product Design." The following topics will be covered: importance of part design; selection of proper material; correlation of physical tests with end use; engineering of purchased molds; selection of molding method; and the relation of molder to design engineer and end user. Fee for the institute is $20.00.

Previous institutes had an average attendance of 100.

3M buys Zenith

Purchase of Zenith Plastics Co., Gardena, Calif., producer of highly specialized aircraft components, by Minnesota Mining & Mfg. Co. for $4 million has been announced. Milton Brucker, president of Zenith, states that 3M's financial backing and the assistance of its research team will enable the company to realize its full potential. He cites Zenith's pioneering in development of electronically efficient reinforced plastics radar housings for aircraft and its manufacturing leadership in this field as 3M's primary reason for the purchase.

Terms of the transaction give 3M control of substantially all of Zenith's assets. Zenith will operate as a wholly owned subsidiary, but the new corporate structure will not affect Zenith operations. Mr. Brucker, who founded the Zenith firm, will continue as its president.

Hubert J. Tierney, vice president in charge of reinforced plastics at 3M, will serve as liaison officer between the parent company and its subsidiary.

Kel-F prices cut

Prices for Kel-F molding powders have been reduced $2.50 a lb. for 20,000-lb. and higher quantities by The M. W. Kellogg Co., Jersey City, N.J.

New prices are as follows: Grades 270 and 300, low density, $6.00 a lb.; high density, $6.50 a lb.; Grade 500-F and 500-R, low density, $6.50 a lb.; high density, $7.00 a lb.; Grade 300-P-325 (plasticized), low density, $7.00 a lb.; high density, $7.50 a pound.

Corresponding reductions for smaller quantities have also been put into effect.

Epoxy news

Registration of the tradename Maraset for its line of epoxy resins for plastic tooling and other production purposes in various industries has been announced by Marblette Corp., Long Island City, N.Y. Until now, the company name has been used to designate the epoxy line which was introduced to supplement the cast and liquid phenolic resins produced by Marblette.

The Maraset line comprises epoxy resins used as casting and impregnating materials for producing tools, dies, fixtures, and jigs used for metal-forming and plastic-forming in the automotive, aircraft, appliance, and other fields; laminating and bonding compounds; surface coatings; and special formulations for non-sag splining and trowelling.

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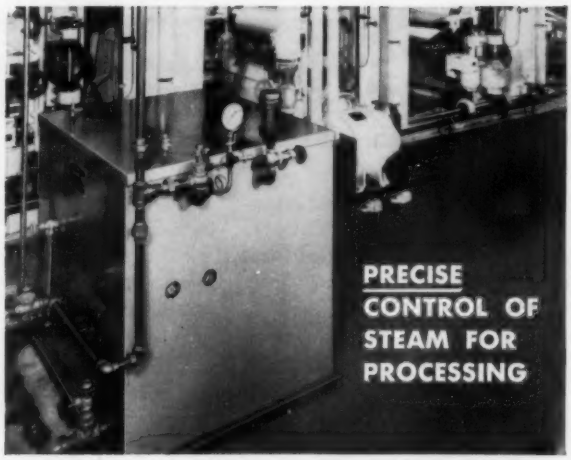
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availability of premeasured quantities of Resin 604A, a thixotropic laminating gel coat with fast cure, and 607, a laminating resin. These resins are now offered in cases holding six 1-pt. cans, along with the requisite quantity of hardeners.

Pressure-sensitive adhesives: Three new room-temperature curing, pressure-sensitive epoxy resin adhesives are now available from Adhesives and Coatings Div., Minnetota Mining & Mfg. Co., Detroit, Mich. Designated EC-1294, EC-1474, and EC-1472, the adhesives can be used for bonding aluminum, brass, copper, steel, and other metals to each other, to glass, and to many plastics. The epoxies are cured with different activators to form epoxy resin adhesives that have 100% solids content.

EC-1294 adhesive cures to a clear, hard, light amber-colored material that has good machining properties and adheres to aluminum, steel, brass, glass, and many plastics. EC-1474 is a lower-cost formula having many of the properties of EC-1294. It is designed for use where cost is a major factor and high shear strengths and light color are not necessary. EC-1472 is suggested for use where good flexibility, shock, and peel resistance is desired.

Self-sterilizing plastics

Invented by Dr. Henri Coutinho and marketed by Bex Industries Inc., 210 Fifth Ave., New York, N. Y. a new range of formulations of a bacteriostat trademarked Corobex, is finding interest among container manufacturers, toy makers, film producers, and molders of hospital and laboratory ware.

The product can be either a clear liquid, formulated for the resin being used, or can be in powder form. When used with polystyrene, it is added at the point of tumbling when the colorant is being introduced. It may also be incorporated in materials such as polyethylene by the extrusion process.

The following claims for efficacy of the products are supported by official records:

1) It is actively antiseptic. Materials so treated are not only free from bacterial contamination; they are anti-bacterial in their nature.

2) Products are self-sterilizing, since they actually destroy bacteria coming in contact with them in a "halo" around themselves.

3) They are self-deodorizing where odors are caused by bacterial activity or decomposition.

4) They are mildew-static, fungi-static, and mold-static. Molds cannot live on Corobex-treated materials and therefore cannot propagate.

5) They are non-poisonous, non-toxic, and non-allergic.

6) No claim is made for insecticidal properties, but it is stated that insects shy away from Corobex-treated materials.

Several proprietary plastics manufacturers have used pilot quantities of the new additive with considerable success. Payton Products, Inc., New York, toy manufacturer; Vantine Co., Inc., Long Island City, manufacturer of nursing bottles; Imperial Chemicals and Plastics Co., Inc., New York; Elm Coated Fabrics, Brooklyn, N. Y.; Harte & Co., Inc., New York, maker of vinyl film; Ideal Toy Co., New York, molder of plastisol toys; Clarolyte Co., Inc., New York, maker of infants' goods; Jason Co., Inc., Hoboken, N. J., maker of tufted laminates; and Royal Mfg. Co., Inc., Prescott, Ariz., producer of blown bottles and containers have used the material.

The first exclusive contract for use has been signed with Royal Mfg. Co., Inc., granting that company an exclusive license for Corobex use in certain plastic bottles, containers, and accessories.

Tests for the efficacy of this type of additive product are based on a) toxicity and b) bacteriostatics. The product has been fed to rabbits, and in 15 feedings no deaths occurred; all animals showed normal weight gains and autopsies revealed that tissues remained normal. In short, the rabbits showed no toxic reactions to doses heavier than those that might be absorbed at any time by humans. Likewise, no irritation was found after application of the product to the eyes of rabbits and to the scarified skin of rabbits. No irritating effects to the skin of eight humans was noted during a 96-hr. period.

From the bacteriostatic standpoint, a test was made on blow-molded polyethylene containers with the result that no growth of bacteria was shown in a 2.2-mil "halo" around the product. On treated vinyl film no bacterial growth on contact was observed and a dim "halo" was created. On a treated vinyl plastisol toy no growth on contact was shown, and the "halo" was 6 mm. across. The company is engaged in a continuing program of evaluation of the product's use with different plastics in a number of bacteriological testing laboratories.

Further work is being done on the use of this bacteriostat in the production of synthetic woven textiles, non-woven textiles, and paper products. To date no work has been done on the thermoset plastics, but tests have been made with all the thermoplastics.

Isocyanates offered

Semi-commercial quantities of two new isocyanates—Papi and Bunco— are now available from The Carwin Co., North Haven, Conn.

Papi, a polyaryl polyisocyanate, is expected to find extensive use in applications involving the reaction of isocyanates with substances containing activated hydrogen atoms. In the coatings field, the compound would find use in bonding elastomers to cloth such as in the manufacture of neoprene-coated tarpaulins and rubber-coated protective clothing. It is also especially promising in the adhesive field for the construction of tire carcasses and in the problems involved in producing damping mounts to avoid

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Color, APHA	< 25	< 25	< 25
EMC* phr at 1,600 psi	51.4	53.7	43.6
Refr. Index n_D^{20}	1.486	1.484	1.447
Visc. cs at 20°C.	74	120	18
Temp. at 100,000 Stokes, Vis., °C.	–42	–39	–70

*Equivalent Modulus Concentration

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vibration of engines. Papi is also considered helpful in improving properties of resins and in increasing the resiliency and raising the heat distortion point of flexible and rigid urethane foams.

Bunco, an *n*-butylisocyanate, is expected to find application in various phases of the textile field, such as waterproofing fabrics, increasing wear resistance of wool, and in tanning hides.

Equipment for urea resins and foam

Equipment for continuous production of urea formaldehyde resin, made in Switzerland and tested in Europe, is being introduced in the United States and Canada by W. H. Kreidl, 57 W. 58th St., New York, N. Y. The standard size unit produces about 200 to 300 lb./hr. (150,000 to 200,000 lb. per month) and is compact in size. The continuous operation is especially attractive to users of urea adhesives. The simplicity of operation and the small space requirement makes the unit ideal at the place of use, resulting not only in reduced cost of the adhesive, but in controlled uniformity at the time of use; the aging problem in transit and storage is eliminated.

There are patents applied for in the United States and most other countries. Non-exclusive licenses are being granted and the equipment is sold to licensees only. Licensees who are not familiar with urea resin chemistry or desire special formulations and know-how may take out an additional optional license. Spumalith Anstalt Vaduz, for whom Mr. Kreidl is U. S. representative, are the licensors and sellers.

Continuous urea foam resin equipment is also being introduced for Spumalith Anstalt Vaduz by Mr. Kreidl. The standard unit produces about 270 cu. ft. of urea foam per hour (about 200,000 cu. ft. per month) of a density of 2½ to 4 lb./cu. ft. One type unit produces granules for insulating purposes. These, for example, can be mixed into concrete for flooring and other purposes. Another type unit makes bats or strips, which are still appreciably thermoplastic when coming out of the dryer, and are warm-pressed to the desired shapes and surfaced with plastic sheeting. They are used as insulating mats for the building trade and for appliances, as well as for packaging of breakable and friable goods—ampules, glassware, candy, chocolates. This urea foam is less brittle than the usual thermosetting foam.

As in the case of the continuous urea production units, licenses are granted on a non-exclusive basis and the equipment is sold only to licensees. Patents are applied for in the United States and most other countries. Licensees who are not familiar with urea resins may take out an additional know-how license.

Vinyl for seat covers

A stock range of vinyl fabrics specifically engineered and styled for the seat cover field has been introduced by Goodall-Sanford, Inc., 1430 Broadway, New York, N.Y. Included in the line is Goodallite Coronado, an unsupported vinyl available in 10 colors, and Goodallite Readington, a cotton knit supported vinyl offered in 14 colors.

Polybutene production by Cosden

Growth trends of the Cosden Petroleum Corp., Big Spring, Texas, are reflected in the recent announcement that it is setting up marketing and distribution facilities for its own multi-viscosity polybutene under the tradename Polyvis. This expanded operation was made possible by the construction of a new polymerization plant at Big Spring, said to have an annual capacity of 1 million gal. of low-viscosity polybutene.

Since the fall of 1953, Cosden has operated a small, semi-commercial pilot plant producing polybutene. The decision to erect a new plant employing several new methods of operation was based on data and experience gained from the operation of this installation. The million-gal. capacity of Cosden's new plant will represent a 25% increase in existing capacity in the United States.

Polyvis is an important component in the manufacture of caulking and sealing compounds, pressure-sensitive adhesives, and in vibration dampeners. Polybutene is particularly adaptable to these formulations because it has an unusually high degree of tackiness in the high-viscosity ranges, but does not become gummy or waxy.

Cosden feels that polybutene has definite, yet undeveloped, possibilities in electrical applications. An intensive research program has been instituted to explore new uses, especially those based on its unusual electrical properties.

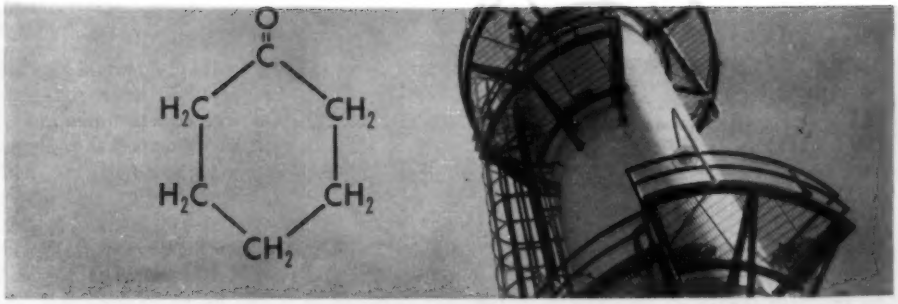
New ink for plastics

High-gloss, water-and oil-resistant ink for flexographic printing of treated polyethylene, Mylar, and saran-coated cellophane has been introduced by Bensing Bros. & Deeney, 3301 Hunting Park Ave., Philadelphia, Pa. Called Safe-T-Brite, the new ink uses a non-toxic vehicle and a high flash-point solvent, which the manufacturer claims eliminates fire hazards in use or storage and reduces insurance rates.

Safe-T-Brite has been formulated to repel water and is said to have the same degree of moisture resistance as impervious coatings, obviating the need for overprint varnish on films that will be exposed to severe moisture conditions. Either natural or synthetic rubber plates and rollers may be used with the ink.

Japanese plastics

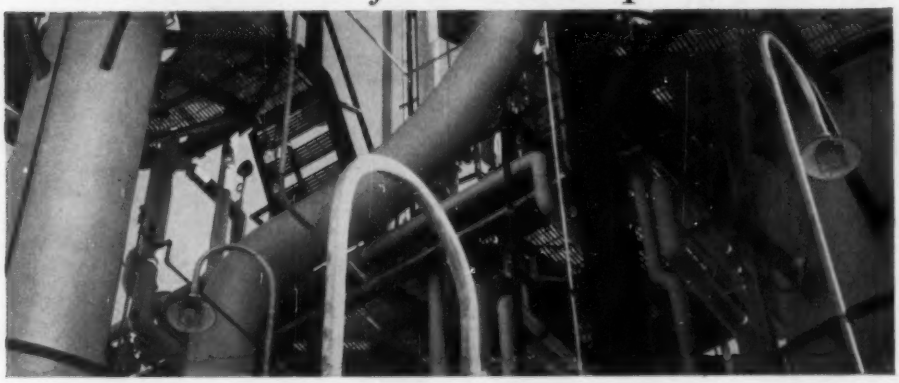
New chemical projects in Japan have a value of more than $350 million, according to Dr. Robert S. Aries, chemical engineer who has just returned from Japan. Among the plastics projects mentioned by Dr. Aries are three polyethylene plants now under construction and two more in the



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The Plastiscope

planning stage; expansion of present plants for acrylonitrile and terephthalic acid; and a 50% further expansion in vinyls. Phenolic resins have doubled in production volume since 1950 to 12,000 tons, while urea resins have quadrupled to 40,000 tons and vinyls have increased 10 times to 45,000 tons.

Face coat for casts

Better epoxy castings and laminates are said to be obtainable through the use of Epocal, a face coat for expendable plaster or gypsum cement casts. Epocal, produced by Furane Plastics, Inc., 4516 Brazil St., Los Angeles, Calif., is a powdered melamine-urea composition containing fillers and the appropriate curing agent to achieve room-temperature cure. Mixed with water, it is applied as a splash coat in the same manner as plaster.

According to Furane, Epocal provides a much harder surface than gypsum cements and will not absorb water after setting (which takes about 15 min. after application). The material is also said to reduce the problem of separating epoxy laminates or castings from the mold.

New Teflon, nylon source

A complete line of stock Teflon and nylon rods, sheets, tubes, and tape in a range of standard sizes is now available from the Mic-Lin Co., Maple Shade, N.J. The line includes stress-relieved Teflon for close tolerance work.

Monsanto centralizes distribution

Marketing activities of Monsanto Chemical Co. in the southern California area will be centered in a newly erected office and warehouse structure in the Vail Field area of the Central Manufacturing District of Los Angeles. The one-story building will accommodate office space for the district sales representatives of the company's Plastics, Organic, Inorganic, and Consumers Product's Divs., as well as warehousing delivery for all of Monsanto products. More than 40 employes will be involved in this new operation.

Electronic quilting

A patent licensing agreement to manufacture and distribute electronically quilted plastics, known as stitchless quilting, has been entered into by Masland Duraleather Co., Philadelphia, Pa., and the owners of the patents, Benjamin Messing and Harry Jacobs, respectively president and board member of Jason Corp., Hoboken, N. J. Jason is the original licensee under U. S. Patents 2,621,138 and 2,621,139.

New styling and constructions are expected to increase the use of stitchless quilting over 25% during the next 12 months, it was estimated by Mr. Messing.

Major licensed producers of electronic quilting now include Jason Corp., The General Tire & Rubber Co., and Masland.

Colorant line offered

A range of concentrated color dispersions for plastics, designated "PC," has been announced by the California Ink Co., Inc., 545 Sansome St., San Francisco, Calif. The colorants are claimed to offer great color strength and to be compatible with a wide range of materials, including cellulose nitrate, acetate, butyrate, vinyl acetate, polyesters, polyurethane foam, chlorinated rubber, and certain acrylics, epoxies, and nylon-epoxy mixtures.

The vehicle portion of the PC color is a polymeric general utility plasticizer. No solvents or dilutents are used in these concentrated colorants.

Expansion

Michigan Chrome & Chemical Co., Detroit, Mich., manufacturer of vinyl plastisols and specialized industrial coatings, has acquired the assets of **Pyramid Plastics Co.**, Chicago, Ill., industrial extruder. The Pyramid facilities in Chicago will be expanded to manufacture and warehouse Miccro products in the Midwest.

The acquisition of Pyramid adds to the present line of Miccro products a complete line of fabricated tapes, tubes, rods, shapes, coatings, and specialized products of all types of plastics materials for industrial use.

Pyramid will continue operations under the same name, with James Palmer continuing as president and general manager. Robert J. Huber is president of Michigan Chrome.

The company also announces the formation of **Michigan Chrome & Chemical Ontario, Ltd.** The firm will engage in the manufacture and distribution of Miccro products in Canada.

Goodrich-Gulf Chemicals, Inc., jointly owned by **The B. F. Goodrich Co.** and **Gulf Oil Corp.**, announces a multi-million-dollar expansion program which will increase annual production of butadiene by 50% to 300,000 short tons in plant facilities at Port Neches, Texas. In 1955, Goodrich-Gulf, together with Texas-U.S. Chemical Co., purchased from the United States government an undivided interest in the Port Neches butadiene plant, having annual capacity of 190,000 short tons.

Work on the expansion has already begun and some of the increased production will be realized late in 1957; full production from the facilities is scheduled for the fall of 1958. The butadiene plant is operated by Neches Butane Products Co.

Product Packaging Engineering has added new executive offices and showrooms to its present facilities at 5747 Marilyn Ave., Culver City, Calif., in an expansion program that will increase production capacity by 30 percent. The company designs and manufactures automatic and semi-automatic heat sealing machines, packaging machines, and the new Pak-O-Vac vacuum forming equipment.

The new 40A Pak-O-Vac model, designed for drape and

Announcing

new upper molding limit for

Acrylic Resin

Du Pont LUCITE 140 acrylic resin is now commercially available in a formulation which permits molding temperatures 30° to 50°F. higher than previously possible with any acrylic resin. The new upper molding limit—the maximum temperature to which the molding powder may be heated for the length of time required in normal molding cycles—presents certain advantages in injection-molding operations, such as increased fluidity during processing and increased stability after processing.

All other physical properties are unchanged, as this improvement is in stability of material at molding temperatures rather than in formulation of a completely new resin.

Increased fluidity

A faster molding cycle is possible in some cases due to increased fluidity. The minimum cycle is primarily dependent on melt temperature, as heat in shot must be removed before the part can be ejected. Therefore, the cooling portion of the cycle remains about the same. But greater fluidity in some molds permits shorter injection time.

The greater fluidity also permits smaller gates and consequently less trimming of the molded piece.

Increased stability

The improved formulation shows greater resistance to craze or deformation on application of solvents. And, because it is now possible to mold more intricate shapes with less strain, in some instances there will be an increase in top service temperature for parts molded of LUCITE 140.

Over the entire molding range, this improved LUCITE will provide thicker sections free from bubbles and thinner sections without surface blemishes. The characteristic sparkle and weather resistance are maintained.

Adoption of this new formulation of the proven LUCITE 140 brings improved properties to molder and end user—and increased profits to both, as this formulation is being provided by Du Pont at no increase in price. For further information write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 3010, Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

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vacuum forming and contour or skin packaging, is now in full production. Also in production are the Comet 54 heat sealing machines and the Pak-O-Mat automatic packaging equipment.

Modern Plastics, acrylic fabricator, is completing a new plant at 4000 N.W. 29th St., Miami, Fla., adjacent to its present location, which will more than triple present capacity. The company has been specializing in plastic replacement parts for commercial and military aircraft since 1940 and in recent years has developed many new plastic items for the aircraft industry.

The additional 9700 sq. ft. of floor space will permit expansion of the firm's custom work in the marine and industrial fields as well as in aviation. In addition to acrylic, the company works with Boltaron, cellulose acetate butyrate, as well as with styrene sheet materials.

American Plastics Corp., a wholly owned subsidiary of **Heyden Chemical Corp.**, has started construction of a factory building at its Bainbridge, N. Y., plant; this will be the second major expansion in 1956.

The company has extensive operations in injection molding, extrusion, and vacuum forming thermoplastics, and fabrication of reinforced plastics; it is also active in the production of casein-type plastics.

Plastic Molders Supply Co., Inc., Fanwood, N. J., has completed arrangements for branch offices and a production plant in Sandusky, Ohio. The new plant will have complete facilities for dry coloring all thermoplastics.

The plant will be managed by A. K. Van Cleef, who will also be in charge of sales. Frank Czech will be in charge of production at the Sandusky facility.

U. S. Plastic Products Corp., Metuchen, N. J., has completed a plant expansion program involving the addition of over 12,000 sq. ft. of floor space. The company will increase production of its standard pearlized Lustrelite and Lustreglow cast acrylic sheeting. In addition, clear and colored non-pearlized acrylic sheeting in many gages is again available.

The Seamless Rubber Co., New Haven, Conn., has acquired **Kraloy Plastic Pipe Co., Inc.**, Los Angeles, Calif. The announcement was made by Arthur Gow, president of Seamless, a Rexall Drug Co. subsidiary.

Kraloy machinery and plant facilities have been thoroughly rehabilitated. Complete pipe testing equipment has been installed to stabilize quality control in the manufacture of plastic pipe.

Additional new facilities are scheduled for the Los Angeles Kraloy plant, and a parallel installation is planned for the Seamless plant at New Haven in the near future. Initially, Kraloy will produce polyvinyl chloride and Kralastic pipe.

Meetings

Plastics groups

October 11-12: The Society of the Plastics Industry, Inc., New England Section Conference, The Wentworth Hotel, Portsmouth, N. H.

December 4-5: The Society of the Plastics Industry, Inc., Seventh S.P.I. Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York, N. Y.

Other meetings

October 3-4: TAPPI Eleventh Plastics-Paper Conference, Institute of Paper Chemistry, Appleton, Wis.

October 9-11: Department of the Air Force with the cooperation of the Departments of the Army, Navy, Commerce, and the National Security Industrial Association, 1956 Joint Military-Industry Packaging and Materials Handling Symposium, Washington, D. C.

October 15-17: American Society for Testing Materials, D-20 on Plastics, Meeting, Chase Park Plaza, St. Louis, Mo.

October 22-24: Annual Paint Industries Show, Cincinnati, Ohio.

October 22-25: Society of Industrial Packaging and Materials Handling Engineers, Annual Protective Packaging and Materials Handling Exposition and Conference, Kiel Auditorium, St. Louis, Mo.

October 22-26: National Industrial Exposition and Management Conferences, Detroit Artillery Armory, Detroit, Mich.

October 23: Society of Plastics Engineers, Inc., Upper Midwest Section, Isocyanate Symposium, Curtis Hotel, Minneapolis, Minn.

October 31-November 2: Society for Experimental Stress Analysis, Annual Meeting and Exhibit, Deshler-Hilton Hotel, Columbus, Ohio.

November 1: Commercial Chemical Development Association, Meeting, Terrace Plaza Hotel, Cincinnati, Ohio.

November 6-8: Packaging Association of Canada, Fifth Canadian National Packaging Exposition, Automotive Building, Canadian National Exhibition Grounds, Toronto, Ont.

November 22-December 3: Society of Industrial Chemistry, Assembly of Chemical Arts, including Special Session on Plastics Materials and Rubber, 28 rue Saint-Dominique, Paris 7, France.

November 27-30: American Chemical Society, Ninth National Chemical Exposition, Cleveland Public Auditorium, Cleveland, Ohio.

December 2-4: Auto Trim Show, Hotel Sherman, Chicago, Ill.

December 4-6: Signal Corps Engineering Laboratories and the Wire and Cable Industry, Fifth Annual Symposium on "Technical Progress in Communication Wires and Cables," Berkeley-Carteret Hotel, Asbury Park, N. J.

December 7: University of Akron, Akron Polymer Lecture Group, Meeting, Knight Hall, University of Akron, Akron, Ohio. Subject: "Catalyst Systems for the Production of Crystalline Polyethylenes."

December 9-12: American Institute of Chemical Engineers, Annual Meeting, Statler Hotel, Boston, Mass.

Companies . . . People

The Borden Co.'s Chemical Div. has acquired the domestic and foreign holdings of **Pioneer Latex & Chemical Co.**, Middlesex, N. J., manufacturer of protective coatings and other products for the textile, flooring, and adhesives industries, and will be merged with Borden's Resinous-Reslac Dept. An undisclosed amount of Borden stock was exchanged for Pioneer's assets—a plant in Middlesex and an interest in Placco Puerto Rico and Placco Colombiana Ltda.

The merged units will be known as the Resinous-Reslac-Pioneer Dept. **Stephen G. Paliksa**, president of Pioneer since its inception, will be assistant general manager of the new operation; **Ashworth N. Stull**, of Borden's Peabody, Mass., plant, will continue as general manager.

Pioneer has grown steadily since its beginning in 1945 and now lists more than 150 products. The firm is concerned primarily with the manufacture of asphalt solutions and emulsions, latex compounds, and natural and synthetic rubber compositions. Resinous-Reslac products include plastisols, organosols, rubber wax hot melts, vinyl and acrylic coatings, heat seal coatings, paper and foil laminates, and resin emulsions and tackifiers.

National Starch Products, Inc.: James Dillon, a vice president since 1954 in charge of the company's Synthetic Resin Div., elected a member of the board of directors. After graduation from Case Institute, he joined National, first serving in the Manufacturing Dept. where he later became manager. **Ralph C. McGaffin**, with the firm for 23 years, will now be responsible for both the Adhesives Technical Service Dept. and the Adhesives Development Dept. to effect closer co-ordination between laboratory development work and field technical service at customers' plants. **William W. Sederlund**, in charge of technical service for over 16 years, will be in charge of the Adhesive Development Dept. **Samuel Gold** will be in charge of Adhesive Technical Service at National's Alexander Research Laboratory, Plainfield, N. J.

National has recently completed a $4 million expansion program, which included construction of a plant at Meredosia, Ill., for the polymerization of vinyl acetate. In 1939, the company's chemists selected vinyl acetate emulsion as the most promising synthetic resin base for high-speed packaging adhesives. In 1941, the demand for military packaging adhesives established the value of these adhesives on a broad scale. The Resin Div. was established and the company began polymerization of vinyl acetate resins in 1946.

Spencer Chemical Co.: F. C. Sutro, Jr., formerly product supervisor of plastics, now manager of technical service of industrial chemicals. **G. N. Olson**, formerly eastern district sales manager in New York City, transferred to Kansas City to succeed Mr. Sutro as product supervisor of plastics. **H. R. Bishop**, north-central district sales manager in Chicago, replaces Mr. Olson as eastern district sales manager. **R. J. Bailey**, formerly product supervisor of industrial chemicals in Kansas City, promoted to north-central district sales manager in Chicago.

Union Carbide—Carbide and Carbon Chemicals Co.: New York district sales office moved from 30 E. 42nd St., New York, N. Y., to 100 E. 42nd St.

Bakelite Co.: The following organizational changes have been made at the Bound Brook, N.J., plant: **Thomas F. Archer**, with the company since 1941, named head of the Planning and Scheduling Dept. He previously served as assistant department head in the Colored Molding Material Dept. and as assistant department head of the Vinyls and Fabrication Dept. **Ezra B. Sharp**, with the firm since 1951 in the Process Development Laboratories, named assistant department head of the Vinyls and Polethylene Fabrication Dept. **Frank J. Skiermont**, with the company since 1948, transferred from the Development Laboratories at Bound Brook to the new Product Engineering Group in New York City. He will be responsible for the promotion of calendering resins in the consumer products market. **Alfred R. Tavarozzi**, formerly at the Bloomfield Research Center, now assistant to the manager of development.

Hooker Electrochemical Co.: Consolidation of Hooker with the **Durez Plastics Div.** and the **Niagara Alkali** organization has been completed. Durez will continue to operate as a divisional entity even though housed with the chemical sales offices. Headquarters for the chemical sales offices will continue to be at Niagara Falls, and for plastics, at North Tonawanda, N.Y. At Los Angeles, Calif., Hooker and Durez now occupy combined branch sales offices in a new building recently completed at 3325 Wilshire Blvd. Their New York City branch sales offices are at 60 E. 42nd St.

Escambia Chemical Corp. is new name of the company formerly known as Escambia Bay Chemical Corp. The executive offices of the president, **R. V. Haslanger**, resins sales manager, **W. W. Peacock**, Jr., and commercial development manager, **A. N. Wohlwend**, are now located at 261 Madison Ave., New York, N. Y. The Research and Development Dept. is located at Cambridge and Newton, Mass.

Allied Chemical & Dye Corp.—Barrett Div.: James E. Shand named assistant manager, Chemical Sales, succeeding the late Richmond C. Quortrup. Mr. Shand joined the technical sales service group in 1946, later serving as special representative. He was promoted to assistant sales manager in 1954 and named assistant to **Leon W. Miller**, manager of Chemical sales, last March. **John H. Lambert** appointed sales representative for Industrial Resins Sales, replacing **W. H. Hough** who

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Companies... People

was recently made Industrial Resins district sales manager of the newly formed New York district office.

Du Pont, Polychemicals Dept.: Dr. Dwight H. Johnson promoted from supervisor to senior supervisor at the Experimental Station; **Dr. George H. Whipple** and **Robert E. Gee** promoted to research supervisors; **Dr. Bruce F. Day** and **Dr. Robert W. Wheatcroft** transferred to the Planning Div. **Dr. Frederick K. Watson**, a senior supervisor in the Research Div., transferred to the Plastics Sales Div. as assistant manager of the export sales section; he joined Du Pont in 1936.

Hercules Powder Co., Inc.: James W. Cleary, assistant manager of the Parlin, N. J., plant, will undertake new work on methyl methacrylate in Wilmington, Del. **J. G. Copeland**, works manager of the Carthage, Mo., plant of the Explosives Dept., will succeed Mr. Cleary as assistant plant manager at the Parlin plant. **Walter E. Whiteis**, formerly operating department supervisor of the Synthetics Dept. plant at Burlington, N. J., named technical superintendent of the Missouri Ammonia Works, Louisiana, Mo. **James H. Gunning**, formerly chemist at the Burlington plant, replaces Mr. Whiteis as operating department supervisor.

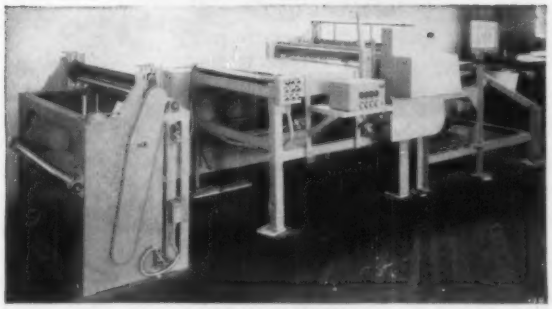
Monsanto Chemical Co., Plastics Div.: John C. Garrels, Jr., formerly assistant general manager in charge of manufacturing, now assistant general manager in charge of marketing, research, manufacturing, engineering, and personnel relations. He joined the company in 1942 as a chemical engineer. **Richard D. Dunlop**, assistant general manager of the division since 1954, now executive assistant to **Felix N. Williams**, vice president of manufacturing, giving particular emphasis to field contacts with manufacturing and all phases of engineering research. In 1939, Mr. Dunlop was named assistant director of research and became technical director of the former Texas Div. in 1947. He was subsequently appointed to his present post when the Texas City operation became a part of the Plastics Div. **A. W. Low**, now director of engineering, will become director of overseas manufacture in January 1957, when **Carl T. King**, manager of overseas plastics manufacture, will retire after 31 years' service. **Francis E. Reese**, associate director of engineering, will succeed Mr. Low as director of engineering. **M. O. Debacher**, now assistant manager of overseas manufacture, will become manager of overseas plastics manufacture in January.

Sun Rubber Co., Barberton, Ohio, has just celebrated its thirty-third anniversary. **T. W. Smith, Jr.**, president, has named an eight-man executive committee and two new vice presidents to spearhead an expanded program of production and sales. The company, large producer of rubber and vinyl dolls, toys, playthings, and athletic balls, is launching a new product development program in the consumer goods field, as well as expanding its Industrial Sales Div. which makes rubber and vinyl products for appliance and automotive manufacturers.

Emet Plastics Corp., formerly known as Emet Vacuum Forming Corp., has moved from 426 Union Ave., Brooklyn, N. Y., to larger quarters at 3500 Park Ave., Bronx, N. Y., providing 20,000 sq. ft. of space for vacuum forming facilities, equipment, and services, including design, models, volume production, silk screening, spraying, finishing, and assembly. The firm specializes in packaging and displays and toys and industrial parts.

Plymouth Industrial Products, Inc., Sheboygan, Wis., manufacturer of low-cost thermoplastic products, elected the following officers: **Aldred J. Simmons**, president; **Thomas B. Gibbs**, vice president; **Gerard W. Mulder**, vice president; **William E. Haack**, secretary-treasurer; and **Robert W. Suckow**, assistant secretary-treasurer. **Clifford R. Palmer** was

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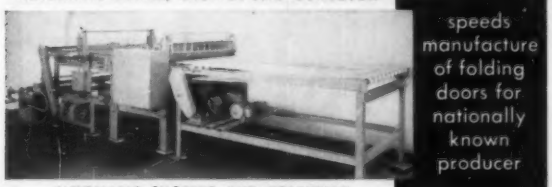


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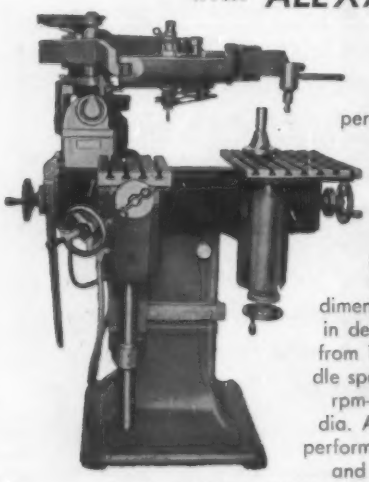
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Companies... People

elected a vice president, in addition to the position of general manager which he now holds. Mr. Palmer recently joined the company as general manager and assumed direction of production and manufacturing activities of the firm's plants at Sheboygan and Plymouth, Wis. He was formerly associated with companies manufacturing precision equipment, valves, and fiber containers.

Joseph Slager named manufacturing manager and **Gordon H. Abler** production manager. Both appointees have been active in the operational management of the company for an extended period of time.

Doram Products, Inc. has moved its factory and offices from 410 Frelinghuysen Ave., Newark, N. J., to larger quarters at 906 Lincoln Blvd., Middlesex, N. J.

The company, manufacturer of varnishes and coatings for vacuum evaporation and silver spraying, now has a complete pilot plant under the name of **Irwin Industries** for the purpose of proving varnishes, coatings, and metallizing processes for customers' products. In addition, Doram offers a personalized service of fabricating, installing, and servicing complete plating plants.

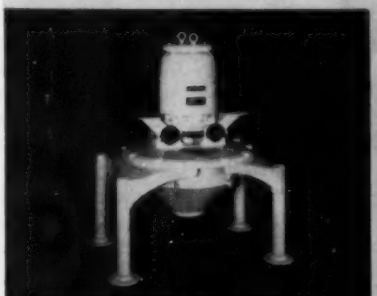
Schwartz Chemical Co., Inc., 326 W. 70th St., New York, N. Y., has appointed 20 representatives to provide sales coverage through most of the United States and several foreign countries. The firm manufactures dyes, lacquers, and adhesives for the plastics industry.

The DeVilbiss Co.: William A. Crandall and **Albert George** named sales representatives. The company produces a line of spray equipment for use with and on plastics.

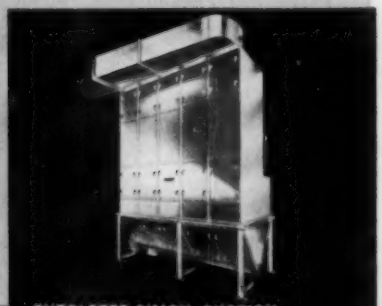
Wilmod Co.'s Plastics Div., 2488 Dufferin St., Toronto, Ont., has formed the **Wilmod Rubber Div.** The division will be operating in Canada and the United States and will carry a full range of light,

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EQUIPMENT FOR...

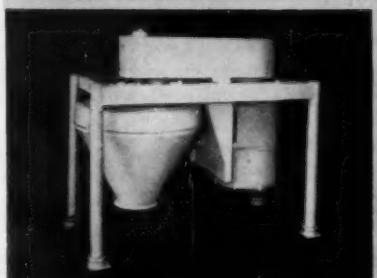
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- DISPERSION
- AIR SEPARATION
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- PNEUMATIC CONVEYING
- DUST RECOVERY



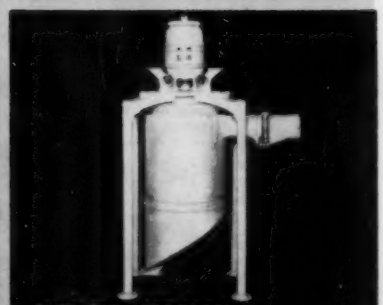
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the most economical, high efficiency dust recovery equipment.



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for grinding and particle size reduction applications with extreme impact velocities and/or capacities to 100 tons hourly.



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simplicity of design, and choke-free operation and low power requirements assure continuous efficiency.

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Produces granules, mats, or slabs, which can be warm-pressed to desired shapes and contours, and surfaced with plastic film in the same production line operation.

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This equipment is manufactured in Switzerland. Patents applied for.

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Companies... People

medium, and heavy plastics and rubber equipment supplied by **Iddon Brothers, Ltd.**, Leyland, Lancashire, England. **John Williams** will head the division as technical sales and service manager.

Dakota Engineering, Inc. is the new name of the firm previously known as **Dakota Plastics Co.**, Compton, Calif. The general office is now located at 6641 Crenshaw Blvd., Los Angeles, Calif. **Francis DeBartolo** is president.

The company produces a line of all-nylon U clamps for electrical wiring in a range of sizes.

Pacific Plasti-Fab Corp., in its fourth expansion of plant and facilities since the war, has moved into newly enlarged plant and administrative offices in San Carlos Calif. The new building doubles the firm's production area and houses an assembly line for large outdoor illuminated signs.

Colt's Plastics Co., Inc., Hartford, Conn., is the new name of the company formerly known as Manufactured Products Corp., following reorganization. **Gregory J. Azarian** has been appointed sales manager. Colt's is a subsidiary of **Penn-Texas Corp.**

Natco Products Corp., manufacturer of plastics and rubber products, is now located at its new plant at 1400 Post Rd., Warwick, R. I., occupying 50,000 sq. ft. of space on a 22-acre tract of land.

Barnett J. Danson & Associates, 1912 Avenue Rd., Toronto, Ont., appointed Canadian representative by **The Watson-Stillman Press Div., Farrel-Birmingham Co.**, Roselle, N. J.

Jesse S. Young Co. named exclusive New York sales representative by **Brown-Allen Chemicals, Inc.** for its Oil Div.'s line of oils, oil specialties, and plasticizers.

Baker Bros., Inc.: A. G. Warren and **J. P. Nugent** appointed regional sales managers—Mr. Warren for the New England and North Atlantic states and Mr. Nugent for eastern Michigan and Windsor, Ont. The company manufactures machine tools and plastic molding presses.

Dr. George Goldfinger, specialist in polymer chemistry, has joined the staff of **Armour Research Foundation of Illinois Institute of Technology**, Chicago. Dr. Goldfinger will be engaged primarily in high polymer chemistry research at the Foundation. Dr. Goldfinger was formerly a professor of chemistry at the University of Buffalo. Previous to that, he was associated with the U.S. Forest Products Laboratory, the Polytechnic Institute of Brooklyn, and Godfrey L. Cabot, Inc.

Leo Roon elected a director of **Rexton Finishes, Inc.**, Irvington, N. J., manufacturer of industrial finishes for the plastics, air conditioning, aircraft, and business machines industries. Mr. Roon is the founder and former president of Roxalin Flexible Finishes, Inc.; he also established Nuodex Products Co. and was its president until 1945.

H. H. Kieckhefer appointed sales manager of the **Wheelco Instruments Div., Barber-Colman Co.**, Rockford, Ill. The firm markets a line of electronic recorders and controllers for measuring and controlling process variables.

James P. O'Connor, Jr. named sales manager of **Industrial Plastic Fabricators, Inc.**, Norwood, Mass. He was formerly with Minnesota Mining & Mfg. Co. Industrial Plastic manufactures PVC machine parts, fittings, nuts, bolts, blowers, and other fabricated units for industrial applications in corrosive atmospheres.

Dr. Frank R. Mayo has joined the staff of **Stanford Research Institute** as a senior research chemist and a member of the Fundamental Research Group in the Physical Sciences Division. Dr. Mayo was with General Electric Research Laboratory, Schenectady, N. Y., where for several years he worked in the field of oxidation of



BOPP

Why not a truly modern Reifenhäuser-Extruder from the start . . . ?

. . . . . not only extruders are modern and automatic in operation, but also take-off units and auxiliary equipment. All offer high hourly output and a first-class product plus dependable performance.

For these reasons REIFENHÄUSER installations assure profitable operations at all times.



The extruder illustrated above has a screw of 3½" diameter. Equipped with proper take-off units it will produce all types of cable coverings, film, piping, tubing, sheeting, blown films, profiles, etc. In addition to the 3½" extruder, REIFENHÄUSER builds extruders with 1¼", 2½" and 6" diameter screws. Why not entrust REIFENHÄUSER with your problems in extruding thermoplastic materials.

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Australia: Swift and Company
26, 28 & 30 Clarence Street, "Geelong House", Sydney NSW.

Canada: Transocean Machine Company Inc.
267 Dunbar Avenue, Montreal 16, P.Q.

Mexico: Huber de Mexico S. A.,
Comte 85, N. Anzures, Mexico D.F.

South-Africa: Kaupe & Wilde, (South Africa) PTY. Ltd.
Cape Times Building,
St. George's Street, Cape Town

Venezuela: VENUFIE C.A.
Avenida Victoria, Apartado 3732, Caracas

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Companies... People

unsaturated compounds. With associates, he discovered phenomena which are of particular interest to the petrochemical and vinyl polymerization fields.

Leo E. Rinal now special representative of **J. B. Carroll Co.'s Display Div.**, Chicago, Ill. The firm produces plastics point-of-sale and other displays.

Jack N. Tincknell appointed vice president in charge of West Coast operations for **Fabricon Products**, a Div. of **Eagle Picher Co.** The company has recently completed a $2 million expansion program at its high-pressure laminating plant in Los Angeles.

Dr. John E. Ward, appointed to a newly created research post with **Nopco Chemical Co.**, will be responsible for the development of product research programs.

Augustus T. De Verra, Jr. named assistant sales manager of **Celluplastic Corp.**, Newark, N. J., producer of plastic vials, jars, and custom plastic packages.

Bernard F. Brehl, Jr. now manager of industrial laminate sales for **General Electric Co.'s Laminated and Insulating Products Dept.**, Coshocton, Ohio.

Herbert Harris, with the firm for 16 years, named to the newly created post of assistant general sales manager of **Visking Corp's Plastics Div.** He was previously central district manager and will continue to hold that position, in addition to his new assignment.

C. Ronald Howey, with the company since 1939, now Development Dept. manager of **Naugatuck Chemicals, Div. of Dominion Rubber Co., Ltd.**, Montreal, Que. He succeeds **C. W. Gates**, department manager since 1944, who has returned to the Naugatuck Chemical Div., U. S. Rubber Co.

Marvin W. Butler appointed eastern sales manager of **Ferro Corp.'s Fiber Glass Div.** His pre-

HELPFUL BOOKLETS FREE!

USES FOR LIQUID VINYL RESINS. Folder describes how to use company's liquid vinyl plastics for coating fabrics, film, metal, and paper suggests applications, lists physical properties. Includes discussion of techniques for slush molding and roto-casting. B. F. Goodrich. **(J-601)**

HOW TO FABRICATE AND FORM VINYL SHEET. 10-page service bulletin describes the fabrication and molding techniques for unplasticized, rigid polyvinyl chloride. Includes data on applications, corrosion resistance, and physical properties. Seiberling Rubber Company. **(J-603)**

POLYESTER RESINS. 24-page handbook describes line of unsaturated polyester resins, transformable into thermoset, transparent plastics. Includes applications, general properties, fabrication techniques, and properties. Pittsburgh Plate Glass Company. **(J-608)**

EXTRUSION DIES AND EQUIPMENT. File folder contains data sheets which describe line of extruders, dies, and other equipment. Includes description of company's sheeting haul-off equipment. Includes specifications. Robbins Plastic Machinery Corporation. **(J-611)**

VACUUM FORMING EQUIPMENT. Folder describes line of vacuum forming equipment and a die press for cutting formed plastic sheets. Fully automatic cycling. Includes specifications, prices. Abbott Plastic Machine Corporation. **(J-629)**

INJECTION MOLDING MACHINES. Illustrated booklet gives detailed information on prices, specifications, and performance of "minijector"-line of ¾ oz. injection molding machines, suitable for laboratory and limited-production molding. Newbury Industries. **(J-640)**

Any of the booklets described here, plus many others—forty-four in all—are available for the asking, without charge or obligation.

Just turn to the Manufacturers' Literature page in this issue (it's printed on heavy colored paper), circle the numbers corresponding to the booklets you want, fill in the reply postcard, and mail. No postage needed. We'll see that your requests are routed promptly to each of the companies involved.

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The search for quality polyesters that deliver maximum erosion resistance and light stability often ends with Interchemical because fabricators of reinforced plastics have learned that IC* Polyester Resins not only possess outstanding durability but also provide dependable uniformity, wet the glass fiber reinforcement easily, and have specialized cure characteristics which meet specific plant conditions. And in order to further minimize production problems most manufacturers choose companion products such as sun-fast, durable colors by Interchemical.

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Shown above is a cotton work glove which Wells-Lamont Corporation of Chicago has converted into a superior, better-selling product through an ingenious application of **chem-o-sol**. This **chem-o-sol** was specially formulated to permit printing on fabrics at high speeds.

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Have invested $8,000.00 in molds for small plastic item ready for manufacturing. Potential sales in New York, Chicago and Philadelphia metropolitan area approximately two and one-half million units. Patents applied for.

We are flexible and will consider any sound arrangement. Reason for decision to sell is that market is too distant from our plant. When replying describe facilities and marketing organization.

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vious associations in the fibrous glass textile field were with Bloomsburg Mills, Soule Mills, and Owens-Corning Fiberglas Corp.

Earl R. Keown, elected to the board of directors and named vice president in charge of sales for **G. Felsenthal & Sons, Inc.,** Chicago, Ill., was formerly executive vice president and sales manager of Santay Corp., Chicago.

Lawrence R. Steinhardt named president of **Narmco Meltbond Co.,** Costa Mesa, Calif. The firm produces Multiwave, a sandwich core material used in the construction of aircraft, missile, and other structures.

William W. Janney, associated with the firm since 1934, named manager of the Export Dept. of **National Vulcanized Fibre Co.,** succeeding **C. V. Geisler,** retired after 43 years' service.

Robert F. Connelly named West Coast field salesman for the Organic Chemical Sales Dept. of **Emery Industries, Inc.,** responsible for sales of plasticizers, dibasic acids, and other Emery products.

John P. Brecker appointed technical director of **Inyestora de Plasticos y Metales,** Monterey, Mexico. Mr. Brecker has had 25 years experience in the plastics industry with Louis B. Marks, Rathbun Molding Co., and recently as general manager of Garfield Mfg. Co.

Paul N. Cheremisinoff now manager of the **Alsynite Co. of America** plant at Paterson, N. J., replacing **Charlie Opel,** who is returning to a home office assignment in San Diego, Calif. Alsynite produces a line of fibrous glass-reinforced translucent panels.

Arthur R. Baum named development supervisor of **Reynolds Chemical Products Co.,** Ann Arbor, Mich., and will head an intensive development and diversi-



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"Difference" is probably the most intriguing characteristic of GREX polyethylene. For instance . . . the difference between GREX and many present day plastics whose sprawling molecular form is suggested above. In contrast with this loose arrangement, GREX presents a close-knit, orderly pattern of molecules. Result: greater strength, better resistance to heat distortion, and a far lower vapor transmission rate. GREX will be available commercially in mid-'57. Our semi-works plant is producing resins now.

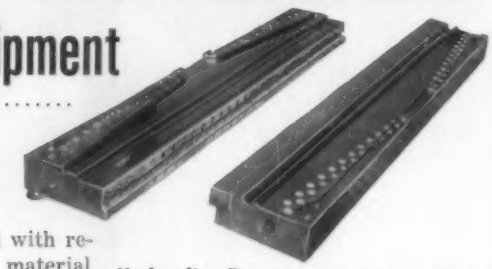
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Sheet Glazer. Designed and manufactured to glaze plastic sheets comparable to film lamination. Retains lustrous finish after vacuum forming. Physical properties not impaired by glazed finish.

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Companies . . . People

fication program underway for both the plastisol and organosol divisions. Mr. Baum formerly held research posts with Michigan Chrome Chemical Co. and with Sherwin-Williams.

Bernard Schiller now works manager of **Brilhart Plastics Corp.**, Mineola, N. Y., custom molders and extruders.

John J. Littley now sales manager of hydraulic and compacting presses for **Baldwin-Lima-Hamilton Corp.**, Hamilton, Ohio.

Warren S. Butler, with the firm since 1947, appointed resident manager of **St. Regis Paper Co.'s Panelyte** plant at Kalamazoo, Mich., succeeding the late **George E. Epley**.

Kyle W. Charlton promoted to operating supervisor of **Mobay Chemical Co.'s Polyester Dept.**

Ernest J. Bondo, formerly of Boonton Molding Co., now manager of manufacturing of **Northern Industrial Chemical Co.**

James F. Primm, formerly with Amerotron Corp., now general export sales manager of **Celanese Corp. of America** for its textile, chemical, and plastics products.

Fred Wolf, named director of research and product development of **Kleen-Stik Products, Inc.**, Chicago, Ill., will head a special department established to explore new product uses and give technical assistance to printers on pressure-sensitive labels.

Frank H. Burgess appointed product development engineer of **Morningstar Corp.**, Cambridge, Mass., plastic custom molder. **John Reese**, formerly with Colt Plastics Co., now executive salesman of Morningstar.

R. Bostwick, formerly research chemist of Irvington Div., Minnesota Mining & Mfg. Co., now with **Bakelite Co.** Development Laboratories at Bound Brook, N. J.

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FOR SALE: Marco Process consisting of: Homogenizer, Roto-Feed Mixers, Reactors, Kom-Bi-Nators and Pumps, all stainless steel. Heavy Duty Double Arm Sigma Blade Mixers. (2) Readco 50 gal. 30 HP; (2) W & P 50 gal. and 100 gal.; (2) J. H. Day 75 gal. stainless steel. (2) Kux Rotary Pellet Presses. (3) Sprout-Waldron Horizontal Ribbon Mixers 336 cu. ft. (12,000#) capacity. Stainless Steel Reactors or Autoclaves— 1420 gal., 465 gal., ½ gal. (1) St. St. Pug Mill 7" diameter x 3'9" long overlapping chambers, jacketed 75#. (4) Mikro Pulverizers #2DH, #2TH, #3TH. (3) Fitzpatrick Stainless Steel Comminuting Machines, Models D, K & F. We Buy Your Surplus Equipment. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: Cutters, Rotary, Plastic: Ball & Jewell Midget 1 HP MD, Van Dorn Model C-100, 1 HP MD, Abbe Size "0" 5 HP MD 9" x 17" Hopper Mouth. Ball & Jewell #1 10 HP MD. Die Casting Machines: Lock Engineering, Zinc, Motor Drive 10 HP. Extruders: Laboratory 2" Screw 1 HP MD Elec. Heated, Royle No. 1, 3 stage Oil Heated, Excellent Condition, No. 2 Royle 15 HP Motor, 3¼" Screw, Elec. Htd. Die Head, No. 3 Royle, 30 HP Motor Drive, 4½" Screw, Side Delivery Q.O. Head, Allen-Williams,, 8" Strainer Head, 40 HP Motor Drive, 4 Zone, Elec. Htd., 4" Screw, 60" Barrel, Practically New. Injection Molding Machines: 1 oz. Van Dorn Model H-200, 2 oz. HPM No. 54 Clamp 22 Ton, Injection 12 Ton, Manual Controls, 2 Oz. NRK No. 1300, Plasticor Vertical, Hand Operated, 2 oz. Van Dorn Model H-200 1953 Never Used. 20 oz. Watson-Stillman Vertical Motor Drive, 3 oz. Fellows Fully Automatic, 4 oz. Demattia Semi-Automatic, 4 oz. Crown Moldmaster Complete, 4 oz. Watson-Stillman Horizontal, 4 oz. Reed-Prentice Wheello Controls 15 HP MD, 6 oz. Watson-Stillman, 8 oz. Reed Prentice Double toggle, 8 oz. Impco Mdl. VF-8, Compress. & Transf. Features, Extra 12 oz. Cyl., 9 oz. HPM 200 Ton Fully Automatic, 2 oz. Watson-Stillman, Frame 6 oz. Cap., Motor Drive 20 HP, 1945, 12 oz. Lester W/Glengarry Weigh Feed, 16 oz. Reed-Prentice No. 10-E-16, Electric Heated, 1948, 22 oz. Impco, Model VF 8-22, 24 oz. DeMattia Model B, Inspect in Operation. Mills, Rubber, Plastic: 16"x40" Farrel, Rubber/Plastic, 4 in Line or Individually, 16"x48" Farrel, Rubber/Plastic, 18"x50" Thropp Motor & Drive all on one Bed Plate, 18"x50" Farrel, Rubber, Plastic, 4 in Line or Individually, 20"x22"x72" Farrel Rubber/Plastic, No. 2 Abbe Eng. Co., Eureka Porcelain Jar Mill, Roller Chain, Motor Drive (2). Presses, Hydraulic: 5 Ton, Logan, Twin Ram 7½ HP, MD, 15 Ton, Stokes No. 200D-2 Automatic (10), 15 Ton Consolidated Self Contained, 20 Ton, Elmes No. 3429P Laboratory, Electrically Heated Platens 8"x8", 25 Ton Consolidated 24"x 30" Self Contained Pump & Motor, 30 Ton, Watson-Stillman Laboratory, Platens 8"x8 "(2), 30 Ton, Baker, Full Automatic Model 958, Excellent Condition, New 1951, 30 Ton HPM Upmoving 12"x12" Platen 12" Dio 12" Str with Controls, 35 Ton, HPM, Down-Acting, Ram 6"x6" Str., Bed 12"x6" Dio 15", Self-Cont., 40 Ton, Francis 4 Opening, 12"x12" Elec. Heated Platens, 40 Ton, Loomis, 4 Opening, 12"x 12" Elec. Heated Platens, MD Self-Cont., 50 Ton, Baldwin-Southwark Angle Molding Press, Practically New, 50 Ton Bliss 20"x20" Platen 60" Str. 60 HP MD, 50 Ton, Stokes, Semi-Auto., Slf. Cont., 50 Ton Bliss Bed 21"x20" Stroke 20" 60 HP MD, 50 Ton Farrel, 12"x12", 50 Ton, Watson-Stillman, 12"x17" Elec. Htd. Platens, MD Pump, 60 Ton Weaver 42" Between Housings, 75 Ton, Farquhar, Up-Acting, 30"x42" Platens, 75 Ton, Burroughs Down Acting Ram 8"x10" Stroke, Platen 17½"x17", 100 Ton, Farquhar, Drawing, Stroke 36", Hi-Speed Appr., Press, Return, 100 Ton, Farquhar, Self-Cont., Down Acting Ram 11"x26" Str. 30"x28", 100 Ton, Watson-Stillman, Platens 13"x 13", Ram 8½x3" Str., MD Pump, 100 Ton, Watson-Stillman, 4-Post, Platens 11¾"x 12". Ram 8"x15" Stroke, 100 Ton, Watson-Stillman, Bed 22"x20", DLO 24", Self Contained, 100 Ton, Lake Erie Hi-Speed, 24"x24" Bed, 12" Dio, Self-Cont., 150 Ton, Carey, Platens 20"x16" Adj., Dio, 8"-28", 200 Ton Elmes 14" Ram x 42" Str. 24"x30" Bed, 250 Ton Niles-Bement-Pond Wheel Press, 275 Ton Watson Stillman Upacting 24"x54" Platens 2-14" Rams, 300 Ton Watson-Stillman Transfer Press 33"x27" Platen, Auto., 300 Ton, Lake Erie, 30"x30" Platens, Self. Cont., Semi-Auto., 350 Ton, Elmes, Self-Cont., Down Actg., Ram 19"x 20" Str., 30"x36", 393 Ton, Farrel, 2 Openings 15", Steam Platens 48"x48", 4 Rams 10"x24" Str., 600 Ton, Watson-Stillman, Hobbing, Motor Driven Pump, 625 Ton, Farrel, Steam Platens 52"x52", Pump, Mtr., Controls, Under Powder, 669 Ton, Morane, 3 Upmoving Rams, 16" Stroke, 750 Ton, HPM, Down Act., Bed 59"x44", Dio 72" Ram 28"x43" Str., 1200 Ton, HPM, 15 Openings, 100"x120" Steam Platens, Self-Con. (2), 2400 Ton, Birmingham, Belt Press, 65"x26'6", 24-11" Rams. Presses, Plastic Molding: 15 Ton, Stokes No. 200D-2 Automatic (10), 30 Ton, Baker, Full Automatic Model 958, Excellent Condition, New 1951, 50 Ton, Stokes, Semi-Auto., Slf. Cont., 50 Ton, Watson-Stillman, 12"x17" Elec. Htd. Platens, MD Pump, 215 Ton, Lake Erie, Semi-Auto., Self Cont., Hydr. Plastic Molding. Presses, Transfer: 300 Ton, Watson-Stillman Hydraulic Transfer Press, 33"x27" Platen, Auto. Furnaces and Ovens: Megatherm 3/60/220, 3 KW, 2-3 lb. Phenolic per min. (8), Despatch Mdl. Diaz-7583, 3 Drawers, 17"x17"x5" (2), Despatch Mdl. PlHD-8, 8' Drawers, 12x 18x21½" (2), Theramex, Mdl. x875, 1 Ph., 60 Cy., 230 V., Thermionic Induction Heater, Lydon, 21 Drawer, Preheating Ovens, Motor & Blower ¼ HP Motor 6'x18"x30". Tablet Machines: Model G-4 Stokes Single Punch Dual Pressure 15 Ton MD, Model T Stokes, Hydraulic Equalizer, Motor Drive, 3 HP, Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP, Model R-1 Stokes, Sgl. Punch, Vari-Speed, MD, 3 HP, No. RB-2 Stokes, 16 Station, Motor Drive, 2 HP, Model RD4 Stokes, 16 Punch, Rotary, Motor Drive 2 HP, Model S-5 Stokes Dual Pressure, 40 Ton, Motor Drive 72 HP, 1952, Model RDS3 Stokes, 15 Station, Motor Drive 3 HP, Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD, No. 2 RP Colton, 16 Punch, Rotary, Motor Drive 1½ HP, No. 3RP Colton, 16 Punch, Rotary, Motor Drive 1½ HP, No. 280G Stokes, Single Punch, Model F, Stokes, Single Punch, MD, No. 5 Arthur Colton, Motor Drive, 3 HP, No. 5½ Arthur Colton, Motor Drive, 3 HP, No. DD-2 Stokes, 19 Stations, US Vari-Drive, 10 HP, No. DD-2 Stokes, 23 Stations, US Vari-Drive, 10 HP, No. DD-2 Stokes, 23 Stations, Reeves Vari-Speed Drive, 7½ HP, Model E Stokes Single Punch 2 Ton Vari-Speed M.D. Pumps: 200 GPM, 2500 Psi Worthington Horizontal, Duplex, DA 3¾"x18". Mixers: No. 9 Banbury, Body Only, No. 3A Banbury, 150 HP, MD, Rubber/Plastic, No. 9 Banbury 200 HP Motor Drive, Inspect in Operation Rubber/Plastic, No. 11 Banbury, Bodies only (2). Calenders: 6"x13" Farrel Laboratory, Like New, 9"x48" American Tool, 2 Roll Doubling, Belt Drive, Rubber, Plastic, 24"x48" Farrel-Birmingham, 3 Roll, 50 HP, DC Motor. Roller Coaters: Union Roller Coater, Model B30-50 Coating & Feeding Machine, 3 HP Vari-Drive. Take-up Equipment: 30" Watson, Type D-c, Take-Up, 30" Royle, Cable Take Up, 36" Royle, Capstan, Take-up. Trimmer: 50-ton Model V Metal Stamping Trimmer Model 1C-¼-6. Slitting Machine: Type 6 Cameron Slitter 42" Width Takeup 7½ HP MD. Johnson Machinery Co., 683-P Frelinghuysen Ave., Newark 5, N.J., What do you need? What do you have to sell?

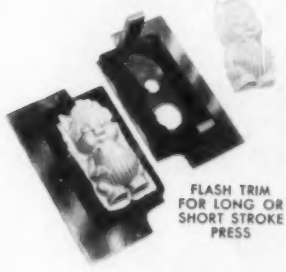
(Continued on page 332)

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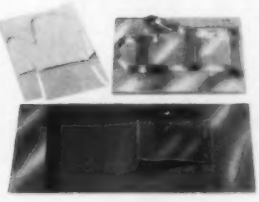
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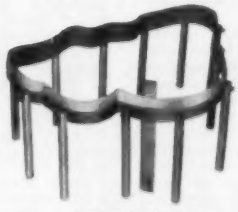
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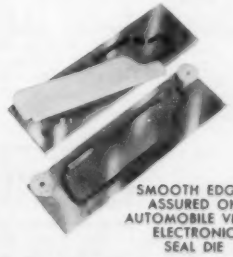
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Polyvinyl chloride	100	100
Plasticizer	50	50
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Stearic Acid	1	1
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100% Modulus, psi	1500	1520
Elongation, %	305	330
SPI Volatility	−0.9	−0.6
SPI Brittlepoint		
Passed, °C.	−25	−25
Failed, °C.	−30	−30
Soapy Water Extraction	%−0.3	+0.2
Oil Extraction	%−6.5	−7.4

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(*Continued from page* 330)

FOR SALE: 1 Stokes standard 150 ton molding press; 1 Watson Stillman 50 ton electrically heated self-contained press; 1 Mitts & Merrill model 10-N-6 pelletizer; 4 Adamson 20 x 20" hydraulic presses, 15" rams; 7 Cumberland #1½ granulators, 3 HP; also mills, extruders, mixers, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N.Y.

FOR SALE: Vacuum Metallizer, Stokes 36". Injection Presses: 8, 12, 24 oz. Reed. 4, 9, 16 oz. HPM. 8, 12 oz. Lester, 4 oz. Lewis, 8 oz. vertical Giddings & Lewis, 1 oz. Van Dorn. Extruder: 2" steam heatd. NRM Saran Pipe setup. Conveyors. Scrapgrinders, No. 1½ Cumberland. Ovens. Compression & Transfer presses: 50 to 600 Tons. —30 T. Elmes Hydrolair. 15 T. Stokes Automatic. 2 KW Cutler-Hammer electr. Preheaters. Auto-Vac 52x30" Vac. Forming mach. Automat. Spray Mask Washer. Day-Mixer size 0. All Midwest Locations. List your Surplus Equipment with me. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

EXCEPTIONAL EQUIPMENT—RE-SALE. Just purchased: Hydraulic Presses; 600 Ton, 300 Ton, 125 Ton and 35 Ton all with Heated Platens; Heavy Duty Baker Perkins Double Arm Jacketed Mixers 300 Gal., 200 Gal. and 100 Gal.; Brand New Falcon Double Ribbon Mixers in Stainless or Steel, all sizes in stock; Devine No. 23 Vacuum Chamber Dryer; Dbl. Door; 13 shelves 59"x78" complete with all accessories; Stokes Preform and Pelleting Presses; Extruders, Strainers, Tubers, Injection and other Molding Presses; Rubber Mills, Calendars, Vulcanizers, Bale Cutters, Rotary Cutters; For fast accurate reply to your inquiry, write to:
First Machinery Corp.
209 Tenth Street
Brooklyn 15, N.Y.

FOR SALE: Markem Printing Machine, high production, semi-automatic dial feed model 25AD-2C Printer, slightly used. Suitable for imprinting plastics, paper, cloth, flat packages, products or parts. Immediate delivery. May be tested in operation. Reply Box 1408, Modern Plastics.

FOR SALE: Hartig 3¼" Plastic Extruder. VanDorn 1 oz. Injection Molding Machine. Stokes R, 2½", single punch, Preform Machine, Kux 2½" dia., single punch Preform Machine. Farrel 15"x36", 2-roll mill. Mills and Calenders up to 84". New Seco 6"x13" and 8"x16" Lab. Mixing Mills and Calenders. Plastic and Rubber Extruders. Oxford 57" Slitter. HPM 1200-ton Laminating Press, 15 openings, 100"x120". Brunswick 225 ton 21"x21" platens. Farrel 200 Ton 30"x30" platens. 200 ton Hobbing Press 18"x14" platens. D&B 140 ton, 36"x36" platens. W-S 150 ton Semi-automatic, 24"x24" platens. D&B 150 tons, 24"x24" platens. Adamson 80 ton, 20"x20" platens. Farrel 200-ton 20"x80" platens. Southwark 30 ton 14"x14" platens, semi-autom. Also Lab. to 2000 tons from 12"x12" to 48"x48". Hydr. Pumps and Accumulators. Stokes Automatic Molding Presses. Rotary and single punch Preform Machines, ½" to 4". Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & J. H. Day Jacketed Mixers. Plastic Grinders. Gas Boilers. Partial Listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn 15, New York. Sterling 8-1944.

FOR SALE: ¾ kilowatt bar sealer, excellent condition, complete. F. A. Richter, 1220 N. State St., Chicago 10, Illinois.

FOR SALE: 10D-8 ounce Reed-Prentice Injection Molding Machine. 1947 model. Machine is in excellent condition and can be seen in operation in modern, clean, well maintained plant. No dealers please. Reply Box 1422, Modern Plastics.

NEW ARRIVALS FOR SALE: French Oil Mill Mchy. Compression Molding Presses; 75-170 tons, 3-170 tons, 35"x18", 5-95 tons 29"x18", 3-75 tons 18"x17", 5 Preheaters 2 KW, Wood 20"x20" 12" ram 170 tons; Southwark 24"x24" 12" ram, 170 tons; Baldwin Southwark 4-26"x26" 8" rams, 75 tons; 5-26"x26" 7" rams 57.7 tons; 2-15"x15" 8" rams 75 tons; 2-19"x24" 10" rams, 78 tons; 2-12"x12" 7½" rams 66 tons; 2-D&B 12"x12" 7" rams, 57.7 tons; 8"x9" 4½" rams, 24 tons; D&B 12"x12" 3" rams, 10 tons; HPM Transfer Molding 75 tons; Preform Presses, Colton 5½T Stokes R and DDS-2 MD; New Universal Dual Pumping Units 3-15 HP; Lab. Mills and Calenders; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. Universal Hydraulic Machinery Co. Inc., 285 Hudson St., New York 13.

FOR SALE.
48" Stokes Vacuum Metalizer; perfect condition. Complete with 2 dollies, carriages, etc. Immediate delivery. May be seen in operation in our plant. Write Box 1425, Modern Plastics.

FOR SALE: 3—Ball & Jewell #2, #1½ Rotary Cutters; 1—Cumberland #0 Rotary Cutter; 4—Two Roll Mills 20"x22"x60", 15"x40", 6"x14"; 3—Baker Perkins 100 gal., 50 gal., 2 gal., jacketed double arm Mixers; 1—Stokes Rotary Preform Press #DDS2; 3—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

FOR SALE: Stainless Steel Rotary Dryer. Link Belt Co., 5'2"x16". No. 502-16, with all aux. equip. Roto louvre also 6'x24' and 5'x26'. Hersey Stainless Steel Rotary Driers. Reply Box 1419, Modern Plastics.

FOR SALE: 1—Royle #4 Extruder, motor driven; 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size O m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers; 5—Horizontal Dry Powder ribbon Mixers, 4000#, 1500#, 500#; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Farrel-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines, 2-16 oz.; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

FOR SALE: (2) 300 Ton W.S. Presses 20x 20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen. Standard Mystic Embossing Presses, Accumulators, Pumps, Valves. 250 Ton W&S 28x24 Platens. 80 Ton Farrel 24x24 Platens. Many other Presses—Send for Bulletin. Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N.Y. Tel.: WAlker 5-8300.

FOR SALE: Injection Machines. Two "Impco" HA-65—2 to 3 oz. Fully automatic. Stroke adjustable to 15 inches. One of the machines we are offering is the machine that was at the 1954 Cleveland Plastics Exposition. F. J. Kirk Molding Co., Inc., Clinton, Massachusetts.

FOR SALE: (11) 75 ton record presses, complete ● $2,450, (11) new 100 ton, 10" ram, 10" stroke ● $1,100, (8) 200 ton, 9" stroke, 14" ram, 36x36 ● $1,850, (7) 200 ton, 9" stroke, 15" ram, 30x30 ● $1,650. (1) 50 ton complete. 18x18 ● $1,850, (1) 200 ton, 16" ram, 30x30 @ $2,450. (2) 200 ton, 16" ram, 42x42 ● $2,850, (1) 200 ton, 15" ram, 42x42 ● $2,450, (4) 250 ton, (2) 12" rams, 30x60 rebuilt ● $3,375. Hydraulic Sal-Press Co., Inc., 388 Warren Street, B'klyn, N. Y.

AVAILABLE OCTOBER 1ST: Steel tank for water or sprinkler services, now in daily use, 40,000 gallon capacity, erected on 100 ft. steel tower. Can be taken down and re-erected in any location at considerable saving. Reply Box 1413, Modern Plastics.

FOR SALE: No. 200H-9—200 ton horizontal (H.P.M.) hydraulic injection molding machine, 9 oz. capacity, with built in motor driven hopper feed and motor driven oil pump. Full information will be given upon request. Reply Box 1401, Modern Plastics.

FOR SALE: 2—Ball & Jewell #1½ Rotary Cutters with 30 HP Motors—Abbe Eng., #0 Rotary Cutter Ball & Jewell Pellitizer—Thropp 6"x12", 2 Roll Mill Stokes Preform Presses Model T-R & #294. Extruders Royle #1-2-3- & 4-Hartig #2 & #3. Equipment Clearing House, Inc., 111 33rd St., B'klyn 32, N.Y.

FOR SALE: 60 oz. H.P.M. w/1200 ton clamp; 48 oz. H.P.M., 1955; 48 oz. DeMattia; 32 oz. Lester, 1950, $22,000; 16 oz. Mod. E. Reed-Prentice, 1948, $13,000; 16 Impco vert. w/10 oz. cyl, $7,500; 16 oz. H.P.M., 1946, $11,500; 12/16 oz. DeMattia, fully hyd., 1951, $10,000; 12 oz. DeMattia, $7,500, terms; 12 oz. Lesters; 8 oz. Reed-Prentice, 1946, $7,000; 9 oz. H.P.M. w/12 oz. cyl, 1945, $7,500; 8 oz. Lester, 1946, $5,500; 8 oz. Leominster, 1946, $3,500; 6 oz. Reed-Prentice 1946, $6,500; 4/6 oz. Reed-Prentice, 1955, w/low pressure closing, fully aut., $10,500; 4 oz. Lester, 1953, fully aut., $8,500; 4 oz. Watson-Stillman vert. 1949, $5,000; 4 oz. H.P.M. 1948, $4,500; 4 oz. DeMattia vert. new; 3 oz. Fellows, 1951; 2 oz. Reed-Prentice, $1,500; 2 oz. Isoma, fully aut., $1,500; 2¾ oz. Clifton, new, $3,350; 2½ oz. Moslo Minijector; used cylinders, grinders; Model F Packaging machine; Auto. spraying machine; Stokes presses; all types new and used plastic machinery—Let us list your surplus equipment. Acme Machinery & Mfg. Co., 102 Grove St., Worcester, Mass.

Machinery and equipment wanted

WANTED: 1½ or 2 oz. vertical Impco in good condition. Reliance Molded Plastics Inc., Woonsocket, R.I.

WANTED: Cellophane Bag Machine, Simplex Model #4, equipped with Electric Eye and Hole Punch Assembly. Reply Box 1404, Modern Plastics.

Materials for sale

FOR SALE—PLEXIGLASS BLOCKS. 20,000 pieces, new, clear, not cracked or crazed. Government Surplus USMC Tank Periscopes, Type M-2. This new block of clear plastic especially suitable for internal carvers and novelty manufacturers. Weight 5 lbs. Price $1.65 each in gross quantities. For details write/call
Central Tire & Salvage Co.
9101 So. Alameda St.
L.A. 2 Calif., Telephone LOrain 9-7175

FOR SALE: Nylon Powder in original containers. Five thousand pounds (5,000#) natural color DuPont 3604, melting 400° F. Viscosity 1.1, otherwise same as current Du Pont 3606. Any reasonable offer considered. Grant Money-Meters Company, 1117 Douglas Ave., Providence 4, Rhode Island.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
A. Bamberger Corporation
703 Bedford Ave., Brooklyn 6, N. Y.
MAin 5-7450

WANTED: polyethylene scrap. Any type or condition. Highest prices paid. Send us samples of your offerings. Box C816, 300 West 43 St., N.Y. 36.

SCRAP WANTED.
Acetate, Butyrate, Polystyrene, Acrylic, any quantity. Also list your surplus inventory of Virgin molding material with us for sale at highest prices.
Claude P. Bamberger, Inc.
1 Mount Vernon St.
Ridgefield Park, N. J.
Tel: HUbbard 9-5330. Not connected with any other firm of similar name.

PLASTIC SCRAP WANTED: All types and grades, any quantity. Write or telephone. Success Plastics Recovery Works, Inc., Post Office Box 506, Indianapolis 6, Ind. Phone Liberty 6-2919.

WANTED: Plexiglas offcuts. Reply Box 1428, Modern Plastics.

WANTED: Plastic Scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 601 West 26th Street, New York 1, N. Y.

INJECTION MOLDER: Wants to buy direct large quantities all purpose polystyrene regrind light colors: Clean: Also Crystal. Reply Box 1414, Modern Plastics.

WANTED: Plexiglass and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. Duke Plastics Corp., 584 Broadway, B'klyn 6, N. Y. Evergreen 8-5520.

Molds for sale

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 1439, Modern Plastics.

Molds wanted

WANTED: Injection molds for making any type of bubble making toys, bubble pipes, whistle, etc. Reply Box 1442, Modern Plastics.

WANTED: Injection mold for making casting rod handle. Advise condition and all details. Reply Box 1431, Modern Plastics.

WANTED: Injection molds for rent or sale. Suitable for Van Dorn H-200 2 oz. presses. Toys, novelties, buttons, games, pipe or cigar holders or any other item. Submit samples and quotations to: P.O. Box 461.—Mexico City 1.—Mexico.

SALES PROMOTION AND ADVERTISING MANAGER

Long established and rapidly growing plastics manufacturer, metropolitan area location, has fine opportunity for man with imagination, and merchandising and advertising experience in the plastics industry. Will direct growing sales promotion and advertising activities. Send detailed resume of personal data, experience, education, references and salary requirements to Box 1440, **MODERN PLASTICS.** Our executives have been informed of this advertisement.



Help wanted

MOLD MAKERS: Would you like to live in California and enjoy its climatic advantages? If so, it would be worth your while to investigate the usuaual opportunities of working with Revell, Inc., the largest manufacturers of plastic hobby kits in the world. Drop us a note giving us your experience in detail. Revell, Inc., 4223 Glencoe Avenue, Venice, California.

PLASTICS EXTRUSION OPERATOR & Ass't Extrusion Foreman: Wanted by progressive New York City firm. Pleasant working conditions, chance for advancement unlimited by "seniority" and other restrictions. Excellent opportunity for right man—applications treated with strictest confidence. Write, giving full details to: President, Box 1416, Modern Plastics.

CHEMICAL ENGINEER: Exceptional opportunity with energetic, progressive, metropolitan New Jersey manufacturer for man with 2-5 years' experience in application research in processing, compounding and formulating of polyvinyl chloride. Experience in calendered plastics, either film or sheeting, preferred. Must be familiar with pilot plant and manufacturing operations. Excellent employee benefits. Send full resume including salary required to Box 1436, Modern Plastics.

PRODUCTION SUPERINTENDENT: for low pressure lamination of fiberglass. We are a small company specializing in large molded items. This is an opportunity for someone who wishes to move to Florida, work in a new modern plant & grow with the industry. Please state full details of experience, salary required, references etc. in first letter. Reply Box 1438, Modern Plastics.

TECHNICAL DIRECTOR.
Excellent opportunity with rapidly expanding plastics processor. Must have heavy background in compounding and coloring of thermoplastic materials. Salary open.
Reply Box 1407, Modern Plastics

WANTED: WIRE AND CABLE SALES ENGINEER. Manufacturer of magent wire, aircraft wire, stranded lead-wire, plastic wire and harnesses, located in Mid-west, has excellent opportunity open for engineer experienced in part or all of those categories, to do liaison work with customers' engineers, cooperating with salesmen. Travelling on an unscheduled basis is required. This is a permanent position, with hospitalization, group insurance and pension plan, all company-paid. Salary open. Reply by letter giving full details of age, education, experience, qualifications. Replies will be held confidential—our employees know of this ad. Reply Box 1433, Modern Plastics.

EXTRUSION ENGINEER: Midwest-AAA-1. Experienced in die design, extrusion techniques, production and fabrication of custom profiles in rigid and flexible vinyl, nylon, and polyethylene. Please send resume of experience, education, references and salary requirements in first letter. Reply is held confidential. Reply Box 1432, Modern Plastics.

WANTED: MOLD ESTIMATOR AND DESIGNER, with at least 4 years experience on plastic molds, good permanent position. Write: Newark Die Company, 24 Scott Street, Newark, New Jersey.

TECHNICAL SERVICE: Flexibility and ease with people, emotional maturity and a sound chemical background are the things we believe would help you greatly in expanding our technical field service program; we are a midwestern organic-inorganic specialty chemical subsidiary of a Big Board company. We think we work fairly hard and we'd like you to plan an active substantial future with us; some experience in the plastic industry, particularly vinyl, is preferrable but not essential. If you are about 30 years old, do not object to travel, why not drop us a note mentioning your background, your salary suggestions and any points you'd like. Reply Box 1417, Modern Plastics.

POSITION OPEN.
Physicist, electrical engineer or physical chemist as Research Associate in Plastics Laboratory for dielectric studies in polymers, to head small group and teach course.
Write L. F. Rahm
Princeton University

MOLD ENGINEER: Responsibilities include design, alteration and repair of injection and compression molds for plastics production. Also responsible for design and selection of jigs and fixtures. This is a permanent position offering long range growth opportunities in a rapidly expanding company. Candidate should be graduate engineer or equivalent with experience in plastics molding. Write giving full details of training, experience, personal background and salary requirements to: C. C. Gadsden, C. F. Church Division of American-Standard, P. O. Box 471, Holyoke, Mass.

POLYMER CHEMIST: We have an opening for a young chemist (B.S.; M.S.) with vinyl-type polymerization experience, laboratory or production. Unusual opportunity with "growth" organization for man ready for bigger responsibilities and corresponding rewards. Initiative and creative ability are prime requisites; familiarity with production control, new product development and research effort on plastics as structural materials is desirable. New England location ideal for outdoors enthusiast. Technical Director, Wasco Chemical Co., Inc., Sanford, Maine.

TIME STUDY ENGINEER: Boston firm is seeking man to set up and install incentive system in custom molding plant. Must have minimum of two years college background inclusive of Time Study, also at least three years' experience in industry of actual execution of incentive. Your reply should state full qualifications. Reply Box 1411, Modern Plastics.

PLANT MANAGER: for rapidly expanding Ohio extrusion plant. Must have at least five years experience in all phases of plant operation, production planning, quality control, personnel, die design. Must be able to assume full responsibility. Mechanical ability to design new equipment desirable. Salary is open and will be equal to experience with opportunity to grow with a fast growing company. Reply Box 1410, Modern Plastics.

MOLDING SUPERINTENDENT: Wanted for established custom injection molding plant. Must be experienced with most thermoplastic materials and molding equipment. A valuable opportunity to join an exceptionally modern operation now in the midst of rapid growth. All replies treated confidentially. Reply Box 1418, Modern Plastics.

EASTERN PLASTICS MFG. CORP., well established and expanding, has an excellent supervisory opportunity available for young chemist or chemical engineer in a unique solventless coating process with wide spread applications. Require background in development, production and application in the protective coating field. All replies kept strictly confidential.
Reply to Box 1437, Modern Plastics.

PLASTISOL CHEMIST: Unusual lifetime opportunity for man with wide lab and field experience in vinyl plastisols and organisols. Desire man with qualifications leading to management of this fast growing division of our Company. Replies strictly confidential. Salary open—with bonus or stock option. Federal Chemicals Corp., 210 Wythe Ave., Brooklyn, N.Y.

MANUFACTURER OF EXTRUSION MACHINES and Accessories has opening for practical engineer with background of experience with extrusion of plastic sheeting. Besides offering exceptional opportunity to grow with a concern that has doubled sales 3 times in the last five years, the opportunity, also to live in a beautiful quiet town on Connecticut shore where there is paradise for the yachtsman on Fishers Island Sound. Reply Box 1403, Modern Plastics.

PLASTICS ENGINEER.
Top opportunity with large Western Pennsylvania injection molder. Responsibilities will be to place molds, supervise design, estimate new work, plan production and take part in management of plant. Excellent future, all fringe benefits provided for. Write stating background. All replies kept strictly confidential. Our employees know of this ad. Reply Box 1441, Modern Plastics.

MOLDING POWDER SALESMAN: We distribute and deal in a complete line of thermoplastics materials, virgin and reprocessed. Require experienced salesman. Rapid opportunity advancement. Send complete resume stating salary desired. Replies held in strict confidence. Reply Box 1443, Modern Plastics.

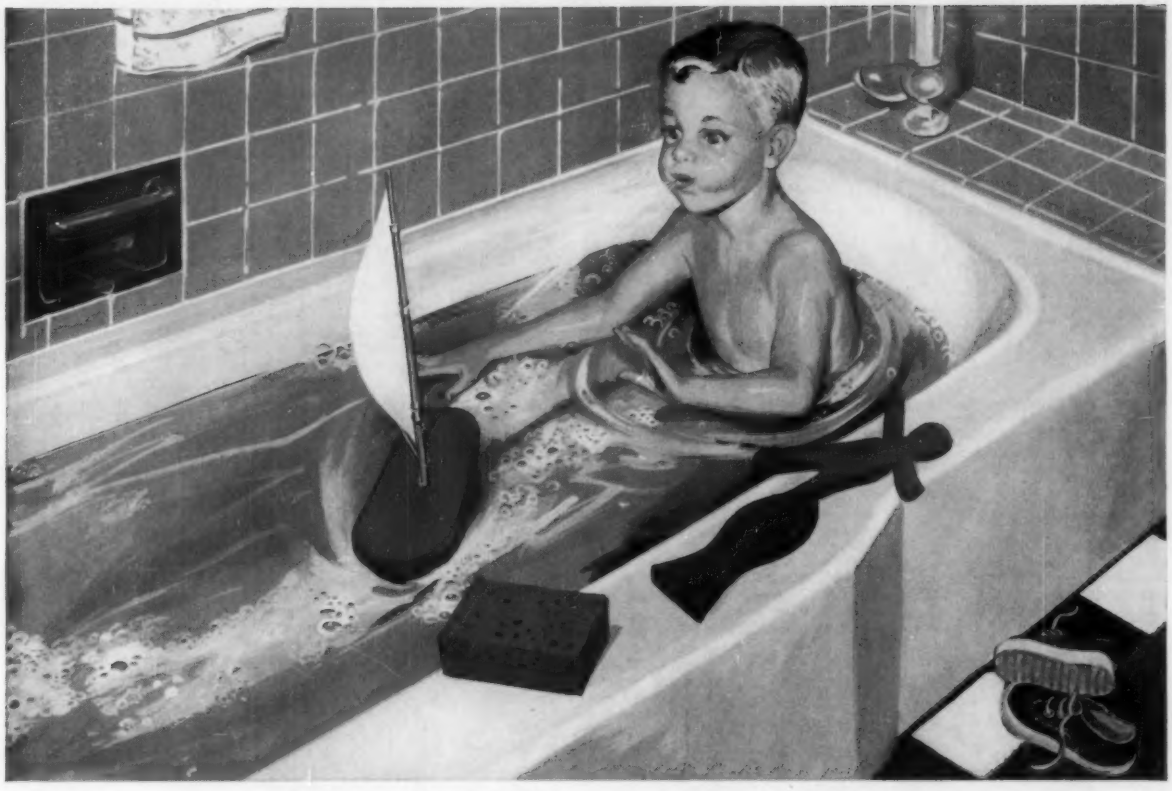
VINYL CHEMIST.
Manufacturer calendered film and vinyl sheeting requires experienced chemical engineer or chemist. All replies confidential. Location Midwest.
Reply Box 1445, Modern Plastics.

MOLDING SUPERINTENDENT: Medium sized Mid-western custom molder seeks man qualified by experience to lead compression and injection departments. To the capable individual that knows molding, maintenance, housekeeping and personnel, we offer top tooling support, expert production control planning and excellent salary in a busy growth company. Reply Box 1444, Modern Plastics.

VINYL COLOR MATCHER.
Man experienced in color matching and production color control in film and sheeting. Reply Box 1446, Modern Plastics.

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non-toxic, non-staining it keeps "blowing" under control

NAUGATUCK CHEMICAL offers the expanded plastics and foam rubber industries *two* highly effective nitrogen-evolving blowing agents. These provide a choice of decomposition (blowing) temperature ranges, permitting proper synchronization with the precure temperature characteristics of the material to be blown. Both are supplied as very finely ground powder that disperses rapidly and uniformly and produces an extremely fine cell structure in either resin or rubber compounds:

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Neither of these organic blowing agents is toxic or imparts any odor to the finished product. Non-staining and non-discoloring, they are more effective, more easily controlled than the inorganic bicarbonates. For complete data on their compounding and use, write for our Compounding Research Reports Nos. 36 and 38.

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Situations wanted

RESEARCH DIRECTOR: Desires new connection with progressive company heavy in functional coatings, laminations, adhesives, elastomer-, resin-, rubber-, wax-, asphalt solution dispersion hotmelt emulsion compounding, film, paper, textile, foil etc. extrusion, printing. Aggressive, resourceful. Granted and pending patents. Reply Box 1434, Modern Plastics.

GERMAN COUPLE, 25, both chemo-technicians several years' experience in the plastics adhesives and cellulose field, looking for employment in U.S.A. Reply Box 1402, Modern Plastics.

ENGINEER FOREMAN: injection molding and finishing, have engineered the job, sampled the mold, established the cycle, handled production problems, and supervised the molding and finishing. Also experienced in compression and vacuum molding. University Graduate presently living east desires returning to Chicago area because of illness in family. Reply Box 1435, Modern Plastics.

WANTED: Extruder To Represent. Thoroughly experienced custom injection molding salesman wants to represent precision custom extruder of polyethylene, butyrate, nylon etc. Established following of injection molding customers need custom extrusions. Territory: Southern New York State, Northern New Jersey and Conn. Reply Box 1430, Modern Plastics.

PLASTICS ENGINEER: B.S., Chemical Engineering, presently engaged in extrusion development seeks association with a future. Five years experience includes process development, equipment design, production, physical testing, instrumentation and quality control. Reply Box 1420, Modern Plastics.

DEVELOPMENT ENGINEER, CHEMICAL: Sound background in plastics and resins, particularly thermoplastics. Broad experience ranging from process and product development and production management to sales and consulting. Knowledge of vacuum forming injection molding, extrusion, epoxy tooling, coating, printing and adhesives. Unusual combination of technical "know-how" and excellent human relations. 31, family. Present earnings in low 5-figures. Reply Box 1415, Modern Plastics.

Sales agents wanted

SALES REPRESENTATIVE WANTED: by custom shape extruder. Interested only in men of proven ability, who are now calling on industrial accounts and handling allied non-competitive lines. Many exclusive territories open. Commission basis. Reply giving qualifications, present representation, and territory desired. Reply to Box 1406, Modern Plastics.

SALES REPRESENTATIVES WANTED: for new plant located in Midwest. Small automatic injection presses. Commission basis. Reply Box 1424, Modern Plastics.

SALES REPRESENTATIVES: Add extruded plastic parts and subassemblies to your present line of plastic products. Protected territory, good factory service. Write for complete proposal giving lines now handled and territory desired. Quick Plastics, Jackson, Michigan.

SEVERAL SALES TERRITORIES: are open for real wide awake and progressive manufacturers agents who are now calling on injection molders and extruders of thermo-plastics and, who wish to become an active factor in the sale of a complete line of dry colorants made specially for 'inplant' coloring. Confidential. Reply Box 1409, Modern Plastics.

POLYETHYLENE SALES.
Spencer seeks a man with enthusiasm, drive and a desire for future progress for a position as Polyethylene Sales Representative. Plastics processing experience is desirable but not necessary. Sales experience is also desirable. Location would be East Coast or Mid-West. Excellent opportunities for future advancement exist in a rapidly expanding organization where annual sales have reached 45 million dollars in its short ten year life. Please send resume of your experience to:
Field Sales Manager
Industrial & Plastics Products
Spencer Chemical Company
Dwight Building
Kansas City, Mo.

MANUFACTURERS' REPRESENTATIVE WANTED: by plastic injection molding company. Established firm doing business over 10 years and specializing in nylon molding is looking for representative in Ohio and Upper New York. The specialized nature of the business calls for someone with background in thermoplastics and its applications. Job could be handled by aggressive concern. Reply Box 1405, Modern Plastics.

Sales Representatives Wanted: Aggressive, experienced, custom injection molding firm, recognized as a dependable source by key industries, has opening for representation throughout country. We back up with active advertising, engineer's field calls, excellent service at competitive prices. We make our own tools, have paint finishing department. Reply giving territory and sales experience. Commission plus incentive bonuses. Box 1427, Modern Plastics.

Miscellaneous

WILL INVEST up to $150,000.—for minimum half-interest in going Plastics manufacturing business. Location preferably West or South-West. Intend be active, former executive, age 45, management and sales experience, chemical engineering background. Will also consider acquiring entire ownership provided continuity management assured. Must stand investigation. Reply in confidence Box 1423, Modern Plastics.

PROGRESSIVE manufacturers' sales agency desires additional lines in Thermoset and Thermoplastic products for states of Indiana, Ohio, and Michigan, or any portion. Interested in rods, tubing, film, sheeting, corrugated fibre glass panels, custom and proprietary extrusions and molded parts, finished vacuum formed parts and any additional products used in automotive, aircraft, household appliances, and building industries. Have excellent contacts. Prefer accounts that are geared to high volume and diversified production, and willing to offer good service to large manufacturers. Will operate under contract on a commission basis. Write Dooley and Vane Company, 18511 James Couzens Highway, Detroit 35, Michigan, or telephone Diamond 1-0247, Detroit.

WANTED: CHEMIST familiar with methyl methacrylate, polyacrylates, and acrylics of high ester who can supply formula for (soft) denture liner write: Vern Baker, Elyria, Ohio.

WANTED: Organization to manufacture and market traveling toy horse, similar to "Wonder Horse." We hold patent on this popular item. We seek arrangement whereby we receive royalty on each unit manufactured and sold. Reply Box 1429, Modern Plastics.

HAVE Miller Rotational Casting Machine and are Equipped to do Contract Work with Vinyl Plastics. B. L. Custer Company, Box 122, Marietta, Ga.

PATENT FOR SALE: Plastic "Fish Trigger" for still fishing, casting, trolling. Not a lure, not a spring, not a hook, not a gadget. It's a patented scientific device that sets hook in fishes mouth first time he strikes. Test Ad cost $97.00, sold $418.00. ¾ oz. Cost 10¢, sells $1.65. Millions can be sold. Reply Box 1421, Modern Plastics.

WANTED: Injection molds—one item or complete line of proprietary consumer articles, also interested in molds for industrial parts such as knobs, handles, fasteners, boxes, etc. Will consider purchasing complete injection plant with end products or parts line. Designers: New items wanted—cash or royalty. Victory Mfg. Company, 1722 West Arcade Place, Chicago 12, Ill.—Estab. 1930.

CUSTOM MOLDERS, EXTRUDERS, FORMERS, FABRICATORS.
Be well represented in the finest market on earth—Ohio, Indiana, Illinois and Michigan. Newly born and raring to go! A manufacturer's sales organization that knows plastic, its application and the mid-west market, will represent your company. Reply Box 1412, Modern Plastics.

ARGENTINE: Manufacturers Representatives and importers for many years want to represent first class manufacturers of Polyethylene, PVC Compounds and Polystyrene Molding Powders in Argentine. Reply Otto Stern S.L.R, Post Box 2031, Buenos Aires.

All classified advertisements payable in advance of publication

Closing date: 28th of the second preceding month, e.g., September 28th for November issue

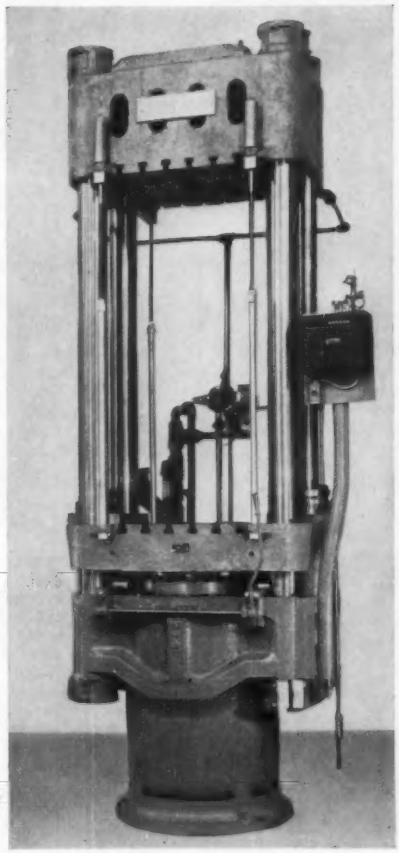
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For further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.

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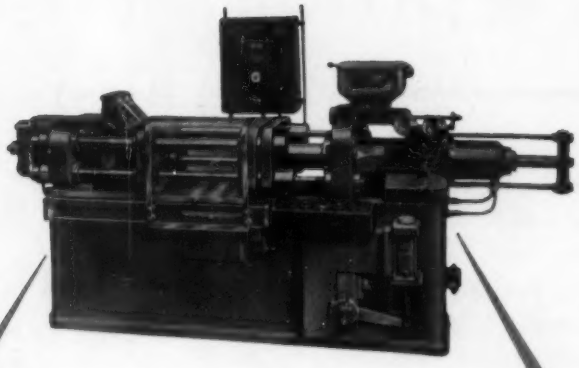
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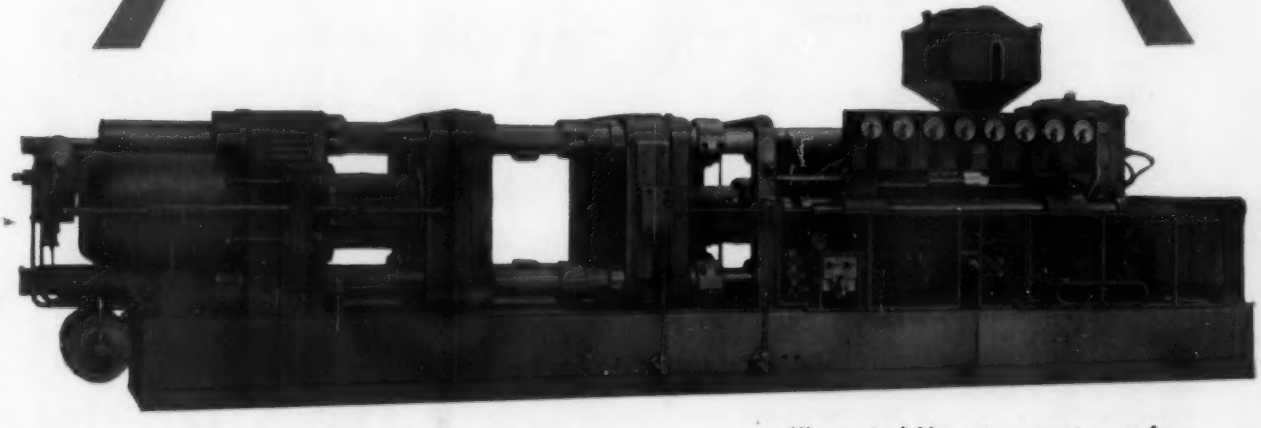
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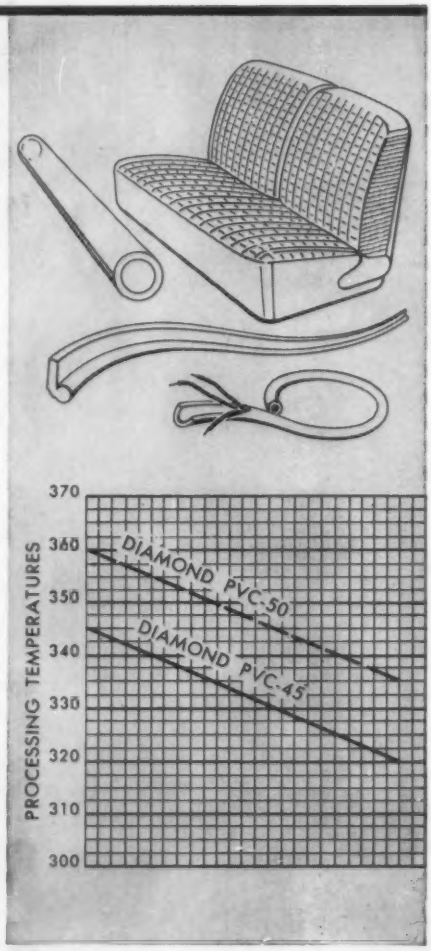
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* * *

For information on DIAMOND PVC resins and technical co-operation, write DIAMOND ALKALI COMPANY, Plastics Division, 300 Union Commerce Building, Cleveland 14, Ohio, or your nearest DIAMOND Sales Office.



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